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Monterey, California

THESIS

MASS DISSEMINATION OF INFOSEC LECTURES VIA THE WORLD WIDE WEB

by
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September, 1997

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The Naval Postgraduate School (NPS) Center for Information Systems Security (INFOSEC) Studies and Research (NPS CISR) invites experts in the field of INFOSEC to NPS to lecture on computer security. Other universities, government, and non-government organizations need similar lectures. Two problems arise: experienced security practitioners are few in number and cannot spend a considerable amount of time on the lecture circuit. Also, for many institutions a regular lecture series would be too costly. To solve these problems a method for mass distribution of the NPS security lectures must be designed.

Multi media tools were used to capture INFOSEC lectures for cost effective mass dissemination. By using the appropriate equipment, computer technology, and software, a tool was developed which can distribute security lectures to an unlimited audience in multiple formats. The resulting product is a tutorial to give content providers a technique to take archived video tapes, digitize them, edit them, and export them. These lectures can be delivered in HTML, compact disk, and video taped formats.

An analysis of the production process yields a set of recommendations for optimizing the user interface and balancing producer and user requirements such as memory conservation, increased product quality, and accelerated remote delivery.

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MASS DISSEMINATION OF INFOSEC LECTURES VIA THE WORLD WIDE WEB

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of the requirements for the degree of

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ABSTRACT

The Naval Postgraduate School (NPS) Center for Information Systems Security (INFOSEC) Studies and Research (NPS CISR) invites experts in the field of INFOSEC to NPS to lecture on computer security. Other universities, government, and non-government organizations need similar lectures. Two problems arise: experienced security practitioners are few in number and cannot spend a considerable amount of time on the lecture circuit. Also, for many institutions a regular lecture series would be too costly. To solve these problems a method for mass distribution of the NPS security lectures must be designed.

Multi media tools were used to capture INFOSEC lectures for cost effective mass dissemination. By using the appropriate equipment, computer technology, and software, a tool was developed which can distribute security lectures to an unlimited audience in multiple formats. The resulting product is a tutorial to give content providers a technique to take archived video tapes, digitize them, edit them, and export them. These lectures can be delivered in HTML, compact disk, and video taped formats.

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I. INTRODUCTION

A. PROBLEM STATEMENT

1. The Communication and Computer Revolution

The world is currently in the midst of a technological revolution. This is not big news as this change has been ongoing for many years. During the late 20^{th} Century, the key technology has been information gathering, processing, and distribution. Among other developments, we have seen the installation of worldwide telephone networks, the invention of radio and television, the birth and unprecedented growth of the computer industry, and the launching of communication satellites[11].

Society has reaped many benefits from these rapid advancements. Teleconferencing, automated commerce, email, and the Internet are just some of the innovations which have made the world more convenient, more efficient, and more flexible.

2. Security in the Computer Age

While the technological advances provide both luxuries and necessities, they also introduce new complications. One problem during this technological revolution is computer and network security. In today's world of international networks and electronic commerce, every computer system is a potential target for malicious and accidental exploitation. Rarely does a month go by without news of some major network or organization having its computers penetrated by unknown computer criminals[4]. Although not a new problem, it is becoming more serious in recent years with the increase of subscribers (individual and organizational) to the Internet. In particular, more and more

companies and individuals place sensitive information on their computers. These same computers are physically connected, either directly or indirectly, to millions of other systems via the World Wide Web (WWW). Subscriptions to the WWW are doubling approximately every year. Unfortunately, not all of these subscribers are benign. With systems becoming connected to other systems at an ever increasing rate, an exploited vulnerability can have far-reaching consequences. There are many threats to the unwary, and in some cases their adverse effects are well documented. A prime example of this is "The 1988 Internet Worm". On November 2, 1988, a graduate student at Cornell University released the first big worm on to the Internet. A "worm" is an independent program that reproduces itself from one system to another, usually over a network[9]. A worm may damage data directly, or it may degrade system performance by tying up system resources. Because of a software error, the Internet Worm replicated too rapidly and invaded Unix systems attached to the Internet - from the National Supercomputer Center to the University of California at San Diego. It shut down many big research sites and universities within an hour of its launch[6].

The problem with security is compounded by the fact that many times the cause of a risk is not intentional, but rather, accidental. Like intentional attacks, however, accidental threats could pose significant hazards to confidentiality, integrity, and continuous service. Again, the cases are well recorded. For instance, in 1991, four of the FAA's 20 major air traffic control centers shut down for over five hours. The cause: fiber cable was cut by a farmer burying a dead cow[8].

Whether accidental or intentional, security risks and potential solutions must be addressed. People must be educated about computer security, even the most casual users.

There are a number of security mechanisms which already exist, and many more will be implemented to mitigate various vulnerabilities. Nevertheless, most people are unaware of the risks and the measures that may be used to avoid them. Therefore, without security as a consumer requirement, designers, engineers, and vendors are less inclined to provide sufficient defensive measures. This disregard for security can and has led to problems such as large scale outages, military debacles, money laundering, and even human casualties.

3. Naval Postgraduate School Security Lectures

Students and staff at the Naval Postgraduate School (NPS) attend lectures from prominent practitioners in the field of computer security. These lectures provide unique perspectives on security risks, cutting edge security technologies, and insights to the future of security. These lectures play a vital role in security education and awareness.

One problem with the lectures, however, is that only a small percentage of military personnel and an even smaller portion of the civilian population attend NPS. Hence, this valuable security information is limited to those who attend NPS. These unclassified lectures should be distributed to a larger group of prospective viewers.

4. Mass Dissemination and Academic Outreach

Using multimedia tools to develop and mass distribute these security lectures to interested government, non-government, academic, and industry organizations can be very beneficial. Ideas from the most knowledgeable people in security will be available to an unlimited audience. Prospective audiences will be kept in tune with current security devices, policies, and future proposals. A more security aware environment will be fostered.

B. SCOPE OF THESIS

The scope of this study is to investigate the use of multimedia tools that will turn security lectures into video taped production (i.e., capture the lectures), create an archive of these lectures, and transform them in forms appropriate for widespread dissemination. If completed successfully, a mechanism will have been produced which can create and mass disseminate these valuable security lectures in multiple formats. They will contribute a convenient, flexible, and cost-effective means to build a more security aware computing and communicating environment.

The following figure provides the reader with a graphical interpretation (from video to the Internet) of the processes discussed in this chapter.

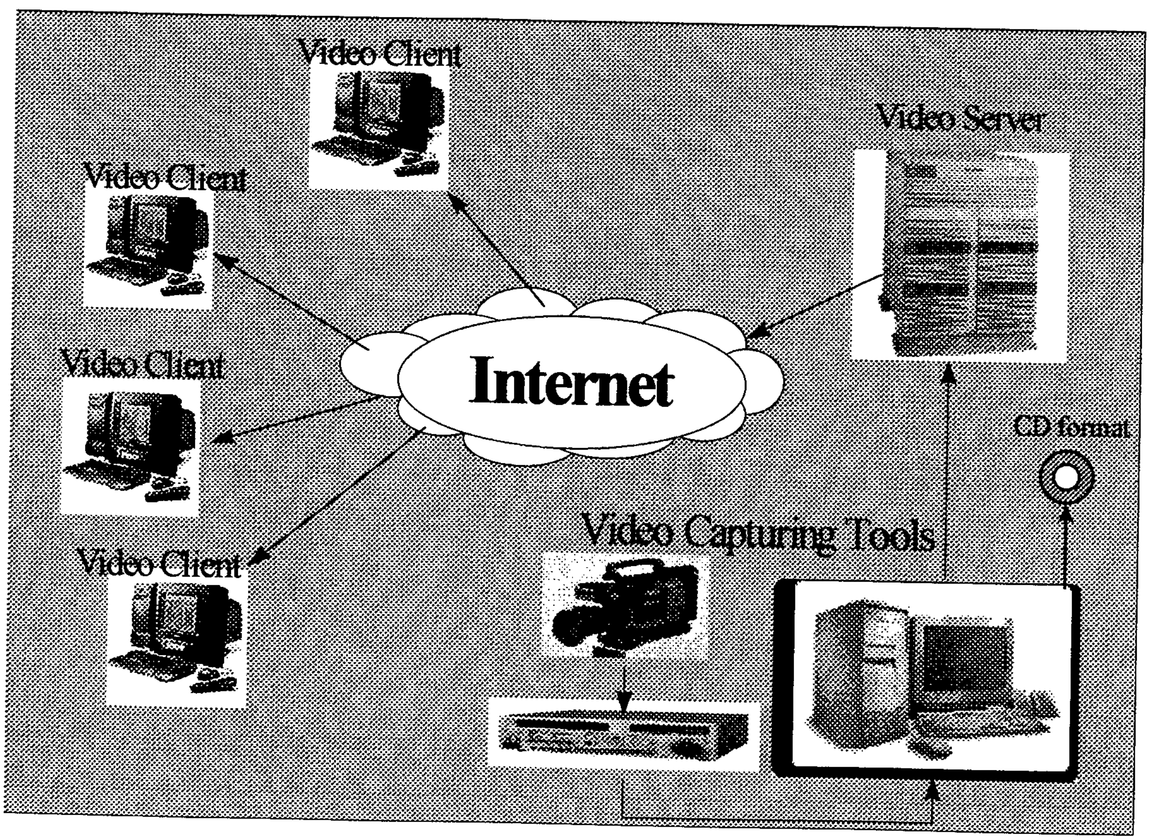

Figure 1: Graphical Representation from Video to Compact Disk and the WWW

C. THESIS ROAD MAP

This chapter serves as an introduction to the entire thesis. A brief synopsis of the remaining chapters follows.

1. Chapter II: End-user Considerations for Accomplishing Objectives

As mentioned earlier, this study is attempting to output a product that can be mass disseminated to end-users in a cost effective and convenient manner. This chapter examines concerns that must be addressed prior to starting the process. Taking into account the possibility of limited end-user access to appropriate equipment and money, this chapter discusses multiple distribution methods which can be employed to relieve both concerns.

2. Chapter III: Designer Considerations for Accomplishing Objectives

In order to achieve a successful study, the author must probe some basic design issues before project commencement. This chapter represents a list of concerns the author must address prior to starting the project.

3. Chapter IV: Technology Employment

After thinking about the concerns from Chapter III, the author must research and decide what technologies to use for a successful completion of this study. This chapter describes the hardware and software employed in this study.

4. Chapter V: The Process

Once every prerequisite to this project is researched and addressed, it is time to render a product. This chapter describes the major chronological steps required for successful completion of the study.

5. Chapter VI: Audio Issues and Experimentation with SoundHack

Chapter VI addresses the importance high audio quality in any disseminated product. It explores a sound processing tool (SoundHack) which may me able to improve aural qualities of any archived video tape. Testing, analysis, and documentation of SoundHack present interesting results and provide some conclusions.

6. Chapter VII: Lessons Learned

The successful completion of any study usually presents a list of obstacles confronted during the process coupled with proposed solutions. This chapter breaks down and discusses all the problems this study encountered during each of its phases. After each obstacle is discussed, it is followed by suggestions for future designers.

7. Chapter VIII: Conclusions and Discussion

This chapter provides a brief synopsis to the entire study and a segment on suggestions for future work in this field.

8. Appendix A: Synopsis of Disseminated Product

Appendix A provides examples of documentation that will be shipped with the product. The purpose of the text is to provide the end-user a brief synopsis of the lecture material being shipped and further references for extended study.

9. Appendix B: Tutorial

Appendix B is an in depth tutorial of the entire process that took place in this study. It provides potential designers with a step by step tool to reproduce the work generated in this thesis.

II. END-USER CONSIDERATIONS FOR ACCOMPLISHING OBJECTIVES

A. PREFACE

Before starting the project, some issues need to be addressed when considering the end-user of the product. As illustrated in Figure 1, this study will attempt to recreate the security lectures in video taped, compact disk, and HTML (Web) formats. The results of this study must be fashioned in a way that is convenient and flexible to the user. The more options a user has to view a product, the more likely the user is to utilize that product.

B. METHODS OF DISTRIBUTION

One assumption this study makes is that the user, if interested in computer security, probably has access to the equipment necessary to play at least one of the media mentioned. Nonetheless, multiple choices should be provided in the case of limited user resources. Moreover, even in the event where all resources are available, the user may desire one media over another. For example, the user may only want to examine certain portions of a lecture. In this instance, the direct access offered by a compact disk or HTML content might be preferred over the sequential access capability of video tape. This is because a video tape would require rewinding and fast forwarding to obtain desired portions of the lecture, whereas a properly formatted CD or HTML page could be accessed immediately. In the case where the user desires to view the entire lecture, and has access to all devices required to play mentioned media, the user would choose the video tape because there is no download time required for video.

C. USE OF COMMERCIAL OFF THE SHELF (COTS)

Another primary concern is the cost to an end-user. The objective is to ensure that the end-user only require commercial off the shelf (COTS) hardware and software in order to view the lectures. It is unrealistic to expect a broad audience to have access to high speed T1 carriers, fiber optics, or any other equipment not available to the common user. The only assumption that should be made is that the end-user have available (one or any combination of) a VCR, a compact disk (CD) reader, or a commercial modem with Internet access. Thus, the distributed product must be in the form of video tape, CD, or HTML provided on a server.

D. COST TO THE USER

This technology must be created in a cost effective manner to the user. Security, as vitally important as it is, can be a hard issue to promote when excessive cost is incurred. Employing any of the three forms mentioned are all relatively inexpensive to the user. A video tape costs approximately $5.00, while a compact disk costs approximately $7.00. As for the users who desire to view the lectures using web content and already have access to the Internet, the cost will be zero, provided the end-user has unlimited access.

III. DESIGNER CONSIDERATIONS FOR ACCOMPLISHING OBJECTIVES

A. LECTURER STYLE

This study must consider the fact that different lecturers have different styles of communicating, and different methods of presenting their material (i.e., slides, graphics, visual aids). All forms of media reproduced from the original lectures must optimize the added value from the visual aids and incorporate them as necessary.

B. MATERIAL PRESENTATION

This study must also understand (by virtue of the fact that these lectures are presented by security experts) that the outcome of this product may be used to enhance future lectures in computer security. Therefore, compact disks and web content should be formatted in an easy to understand outline. This supports the use of individual video clips to enhance current security material.

This is also advantageous to the end-user who chooses to view the lecture over the Internet. The typical Internet user employs either a 28.8 or 33.6bps modem. It is understood that video and graphics are data intensive. Therefore, breaking the video down into smaller pieces makes downloading more manageable.

C. AUDIO ISSUES

When mass distributing compact disks or HTML content, the most important issue the designer must be concerned with is the aural quality of the product. While the overall goal is to render a product that achieves excellent visual and audio qualities, it must be understood that a minimum acceptable audio quality level must be met. It is a fact, when presented the choice of high visual or high audio quality, the end-user will select high

audio quality. To put this point into perspective, use television as an example. If the picture is visually clear and the sound is poor, it is very difficult to completely grasp the subject content. On the other hand, if the sound is clear and the picture is poor, a complete understanding of the material can be achieved. This is why radio is still around and silent movies no longer exist.

Given the previous, it must be assumed that some video taped productions will not possess acceptable audio quality. Poor audio transpires for a variety of reasons: speaker may have poor inflection, background noise may be present, technical problems may have existed when video taping, etc. Therefore, finding a tool (or software) which can improve the audio quality of the video tape prior to formatting it for CD or HTML distribution must be researched.

D. USE OF CURRENT TECHNOLOGY

Current technologies which can aid in this process must be researched. There is no reason to reinvent the wheel. The key to this study is:

- defining the problem
- finding the proper tools which can aid in a solution to the problem
- applying those tools in an appropriate manner to derive a solution
- testing for correctness
- documenting the process for future use.

IV. TECHNOLOGY EMPLOYMENT

A. PREFACE

Before performing the actual process it is important to identify all equipment, hardware, and software that are essential for the satisfactory completion of this study. This provides readers and future implementers of this process with an understanding of the tools necessary to reproduce this project. The tools employed in this study are not the only tools of their kind on the market. Different hardware and software exists that are similar to the ones utilized in this study, and their costs may vary significantly. However, the primary concern in this study is not cost to the originator. The primary issue is to find multimedia tools that can be used disseminate a cross platform product in a form that is readily available and relatively inexpensive for the end-user.

B. CAMERA AND VIDEO RECORDING EQUIPMENT

The procedure starts with video taping the lecture. This is the base upon which all subsequent processes rely. Therefore, using quality equipment is imperative. For this project, a Panasonic SuperCam S-VHS Digital Signal Processing Camera/Recorder (AG-DP800) is utilized. It is worth noting that whatever camera equipment is used; it should possess consistently reliable performance, and be capable of transforming video into high quality digital material.

The next step in the process is to choose the video cassette, or magnetic media. It is important to use Super-VHS(S-VHS) video cassettes. The video cassette production is the analog source medium that is transformed into digital data. S-VHS provides better audio and video than conventional VHS without a substantial increase in cost. Further,

unlike VHS, S-VHS is automatically time synched for precision video editing. Maxell XR-S Black S-VHS video is employed in this project.

At a minimum, one S-VHS video cassette player is required – two for the convenience of copying the original for backup. This study will use Panasonic (AG-7750) and Sony (SVO-5800) video cassette players.

C. COMPUTER AND PERIPHERAL EQUIPMENT

In order to convert the audio and video of magnetic media into a compact disk or HTML, a computer system and multimedia peripherals are required.

1. The Computer System

An Apple Power Macintosh 9500 was chosen. A Macintosh is required because the multimedia software selected to convert the video into various multimedia formats is strictly Apple Macintosh compatible. The following points are worth mentioning with reference to equipment and software utilized in this study.

- Equipment and software chosen for this study were based on research and availability.
- Once the material is transformed to the exported CD and HTML formats, a Macintosh is not required for the end-user viewing.
- Additionally, this does not mean that those who want to repeat this study (i.e., design the end product) require the Apple Macintosh products.
- Future designers must make sure the system employed (and its peripherals) match the software requirements.

2. System Requirements

The primary software employed in this study is Media 100 (see Chapter VI, Section D, Subsection 1). The following list describes the minimum system and peripheral requirements required to operate Media 100. For the purpose of this study, some of these

minimum requirements were inadequate. System and peripherals employed in this study, if different than required, are annotated in parentheses:

- Power Macintosh 9500, 8500, 7500, or 7200 series (9500)
- A 14-inch or larger (17 recommended) Apple/compatible display monitor capable of being set to "millions of colors" (20-inch)
- 40 megabytes of memory with base product, 48-64 megabytes for add-on options (64 megabytes)
- One or more external hard disk drives with at least 1-gigabyte capacity and a sustained data rate of at least 4 megabytes per second (17-gigabytes)
- Apple System 7.5 or later
- QuickTime 2.0 or later version (2.0.1)
- One videotape recorder (VTR)
- Amplified Speakers

3. Compact Disk Recorder

Since a compact disk version of the lecture will be created, a CD-ROM burner drive and some recordable/writable CDs are essential for production and testing. As for the CD-ROM burner drive, there are many on the market and the creator need only assure that the burner of choice is compatible with employed computer system and peripherals.

4. Compact Disks

The only requirement for compact disks is that they should support at least 65 to 72 minutes of data, which is approximately 650 megabytes. As mentioned, these productions are graphic and/or video intensive, and thus, demand large amounts of disk space. Even though the source generated by digitizing is not recorded on the compact disk, a one hour production will still need at least 550 megabytes. This study used 3M CD-Recordable (CDR) compact disks with 650 megabytes of space (72 minutes of playing time).

D. SOFTWARE

Software is the tool necessary to transform the video into compact disk and HTML content. The software used for this project are:

1. Media 100

Media 100 is a digital video system that empowers video and communications professionals to compose high quality video and multimedia programs from start to finish[7]. Media 100 allows the user – utilizing a previously taped lecture – to digitize, export, trim, adjust, apply audio synchronization, add color effects, create titles and graphics, etc. It is the bridge between the imported product (video tape), and the exported products (compact disks and WWW content).

2. QuickTime

QuickTime is the multi-platform, multimedia software used to create and deliver synchronized graphics, sound, video, text and music. With QuickTime the designer is only required to author once, then can playback the multimedia anywhere. This software takes the digitized and edited video from Media 100 and plays it as movies that are cast to the Internet or recorded onto write once read many (WORM) compact disks. QuickTime's multi-platform feature makes it valuable as different users employ heterogeneous systems. A QuickTime movie can be manufactured (by a designer) and/or accessed (by an end-user) on an virtually any system, provided the user has a version of QuickTime downloaded to their system. QuickTime can be downloaded from the Internet for free at see <http://www.quicktime.apple.com/sw/>.

3. Adobe PageMill

In order to upload the multimedia to the Internet, a web page is essential. Adobe PageMill software supplies all the tools necessary to design, and create web pages for use on the Internet[1]. A beta version of Adobe PageMill can be downloaded from <http://www.adobe.com/prodindex/pagemill/main.html>.

4. Anarchie 2.0.1

Anarchie is a File Transfer Protocol (FTP) client for Macintosh. This software allows the designer to browse FTP sites, and upload and download files. Anarchie is employed in this study to upload clips to a web page. A free version of Anarchie can be downloaded from <http://www.stairways.com/anarchie/index.html>.

5. Astarte Toast CD-ROM Pro 3.0

Astarte Toast CD-ROM Pro 3.0 is the compact disk burner software required to record the digitized and exported production from the system disk drive to the writable CD. Information on Astarte Toast CD-ROM Pro 3.0 can be located at <http://www.zdnet.com/macuser/mu_1096/reviews/review08.html>.

6. SoundHack

SoundHack is a software which performs various soundfile (audio) manipulations. This software is strictly Macintosh compatible. SoundHack will be employed to sample audio quality via spectral extraction, spectral mutation, spectral dynamics processing, soundfile convolution, phase vocoder, and gain change. A trial version of SoundHack can be downloaded from <http://www.gmeb.fr/SoftwareCompetition/SoundHack.html>.

V. THE PROCESS

A. PREFACE

The intent of this chapter is to provide the reader with an overview of the processes involved in generating the product. A more detailed description of each procedure is provided in Appendix A. This chapter will assume that a video tape has already been obtained.

B. THE PROJECT

When the security lecture is video taped and a copy is made, the first step is to digitize the analog source from the video. Before digitizing can occur, though, a Project must be created. The digitizing software, Media 100, is "Project" based. Everytime Media 100 is launched, the user must either create a new Project, or open an existing one. The Project maintains a status accounting for collection of bins and programs. Bins serve as storage containers to hold the video clips the designers will be working on. Programs assemble and integrate visual and audio media to create a complete presentations (see Chapter VI, Section C). The Project is the master control for a collection of bins and programs[7]. See Figure 2.

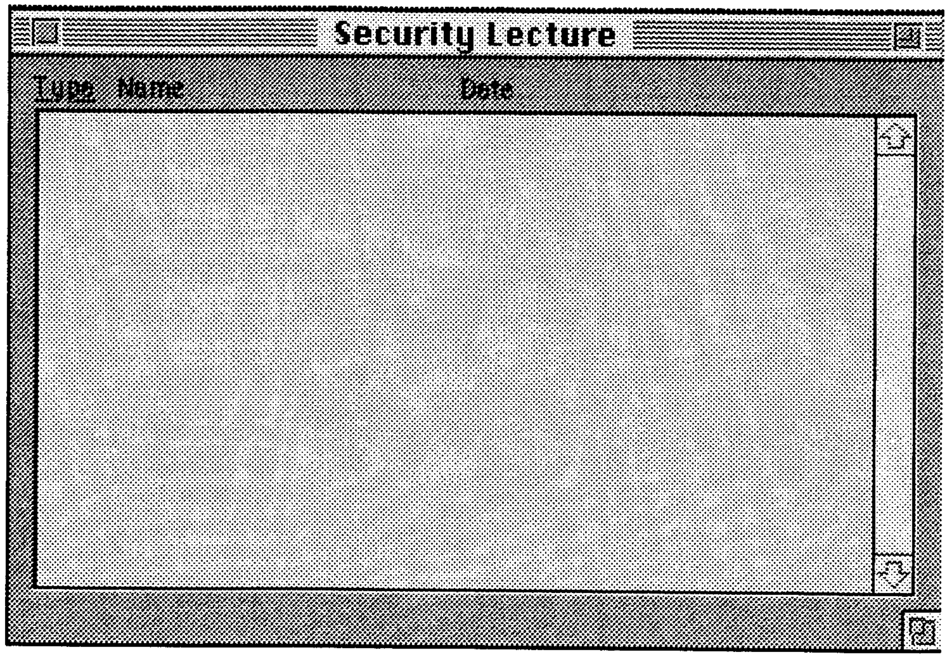

Figure 2: Program Window From Ref. [7].

See Appendix A, Section A for a detailed description of Project creation. See Appendix A, Section C for instructions on re-opening an existing project.

C. PROGRAMS

Programs are created within the Projects. A program is the visual window interface in which the author combines sequences of video and audio clips to form entire productions. A program is the primary interface for editing digitized video, audio, and graphics prior to exportation.

D. DIGITIZING

As mentioned earlier, Media 100 takes analog signals from a video and/or audio source into digital data when in digitize mode. Digitizing video physically transforms the separate video and audio analog signals, which is the native format for videotape, to

independent video and audio digital signals, which the native format for a computer. The digital version of video can be manipulated. See Figure 3.

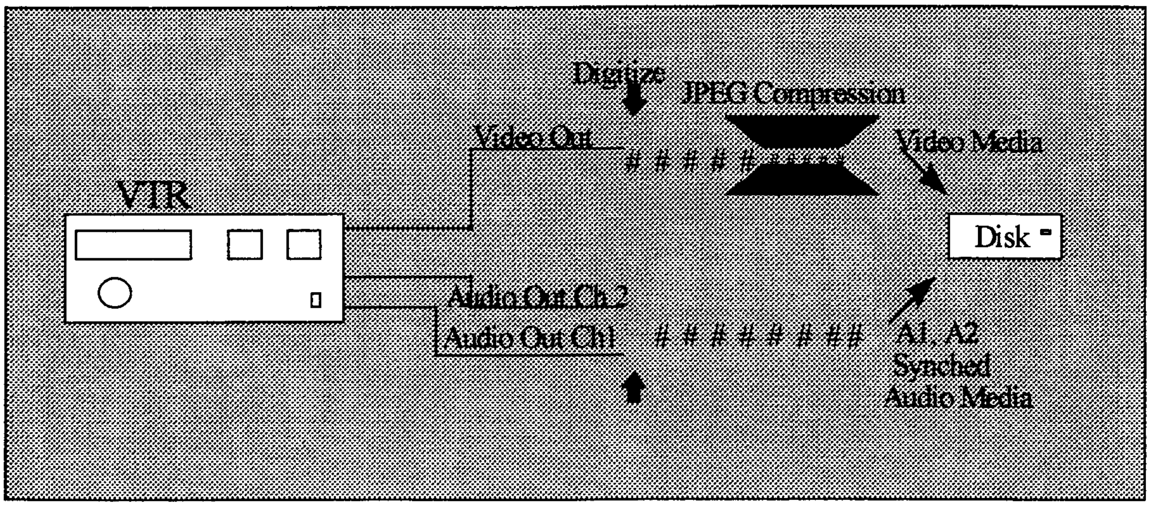

Figure 3: Graphical Interpretation of Digitizing and Compression After Ref. [7]

To conserve disk space, the video portion of the tape undergoes JPEG[16] compression before it is stored in a file. The audio segment requires significantly less storage, and it is stored uncompressed to preserve its pre-digitized quality. See Appendix A, Section C for detailed instruction on digitizing.

Audio and video are synchronized via the Media 100 Junction Box, which reads a timecode on the video as it goes through compression. The timecode is derived from the VTR. Media 100 matches the duration of the audio to the frame count of the associated video.

Digitizing is accomplished through Media 100's "Edit Suite Window". The Edit Suite Window is also the primary control for perfecting the video clips (edit, trim, transition, graphics, etc.). See Figure 4.

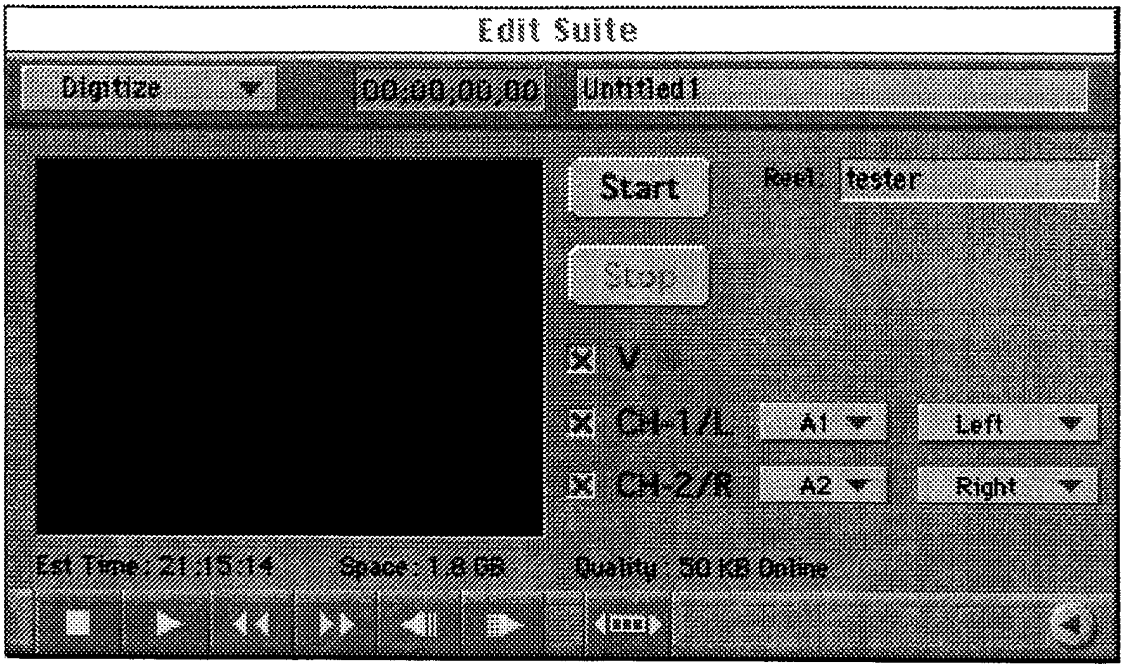

Figure 4: Edit Suite Window From Ref. [7].

This procedure is performed for every video clip of the entire lecture. Note: potential designers considering a project similar to this should preview the video prior to digitizing. The video should be divided into small, smoothly transitioned, and manageable clips. This process will provide greater content understanding and more acceptable download time for the end-user. After viewing the video the designer should construct a well ordered, properly segmented outline to ensure the previous. (see Chapter VI, Section C).

E. EDITING

Editing encompasses all the steps the designer desires to perform on the digitized video clip prior to exporting it. The editing techniques being employed in this project are:

1. Dragging Clips into a Program

Dragging a clip into a program is the process of grabbing a clip from the Bin Window and dragging it into the Program Window. This is basically the first step in editing, as most editing of clips takes place after the clip is placed in the Program Window.

2. Trimming a Clip

Trimming a clip is the process of taking a clip and adjusting the In point, Out point, and/or duration. The In point is the first frame of a clip. The Out point is the last playable frame; the frame adjacent to the last frame.

3. Synchronizing Clips

Synchronizing clips is important for linking clips together when a portion of the video tape has been omitted or when an entire production is made from pieces of a video (i.e. cut and paste). As mentioned earlier, video and audio are automatically synchronized by the Media 100 Junction Box. If none of the video tape is omitted, then video and audio will not become unsynched. Hence, re-synching will not be required. However, when synchronizing of video and audio is required, it is perform in the "Program Window". After dragging the video and audio clips from the Bin Window to the Program Window, the designer must drag the video clip to match the audio clip's timecode. This process must be repeated for every clip in the production.

4. Adding a Graphic to a Clip

This step is performed during the portion of a presentation when the lecturer is referring to a visual aid. Adding a graphic to a clip is the process of creating a visual aid to associate with the audio portion of the presentation. Note: when a graphic (vice video) is associated with a certain segment of audio, the digitizing phase should have only audio selected. This ensures the video portion of that segment does not get digitized as it is not required. When the segment of audio has been digitized, it is dragged into the Program Window. Once in the Program Window, the Graphics option is selected, then the designer selects "edit" from the Edit Suite Window. This will bring up a Graphics Window into which the designer can inserts the desired graphic. Again, this step must be repeated every time a graphic is required.

5. Adding a Black Clip

A black clip is used to add black video to a program. It is especially useful for fading in and out of program segments (making a smooth transition from one segment to another). A black clip is dragged and trimmed like any other clip and can also be synchronized with audio. This step also take place in the Program Window.

6. Adding Text to Video

Adding text to video is the process of dragging a video clip from the Bin Window (which already has the audio and video synchronized) into the Program Window, then adding text to the clip in the same way a Graphic is added to an audio clip. This process is repeated for every video clip that requires text.

F. EXPORTING

When a video clip is digitized and edited, it is ready for exportation. This process takes the video from the Edit Suite Window and exports it to a variety of external applications in QuickTime format (all Media 100 files are QuickTime movies). This procedure is of primary concern to the originator as it provides dialog boxes that allow for multiple settings to tailor the exported file for quality, storage, and speed. This process allows the creator to dictate frame size, frames per second, key frame, audio options, video compressor type, and compression quality. A lot of testing is required for this process as there are many different combinations to choose from. The following chapter examines these options and their tradeoffs. The right combination is completely dependent upon the creator's motivations (i.e., the combination of quality vs. the cost of resources). Because video will be introduced to the Internet, and video is data intensive, this project applies a combination of the lowest settings with minimum acceptable visual and audio levels across the board. (See Appendix B, Section E, and Chapter VI). Again, this procedure is performed for every video clip of the entire lecture.

G. PRODUCT DELIVERY

1. Video Taped Production

As mentioned earlier in this chapter, an assumption is made that a video tape has already been obtained. If the end-user desires the video taped format of the security lecture, the designer need only make a copy of the video tape and deliver it.

2. CD-ROM Production

If the end-user desires a compact disk version of the security lecture, then a CD must be manufactured. This step can only take place once the security presentation has

been created and saved to a creator-selected file. The CD format is one of the multiple distribution options the author provides for prospective viewers. Refer to Appendix A, Section F for a description on how to record a CD-ROM production onto a WORM CD using Toast CD-ROM Pro 3.0.

3. Uploading the Lecture to a Web Page

The user may also desire to view the security lecture via HTML format. Therefore, the next step is to upload the security lecture to an Internet web page. This procedure requires three sub-procedures.

a. Web Page Creation

The author must create a web page. This study employed Adobe PageMill as the page maker of choice. Adobe PageMill is compatible with Macintosh, Windows95, and Windows NT 4.0 operating systems. A trial version can be downloaded from <http://www.adobe.com/prodindex/pagemill/main.html>. Future designers may use any page maker desired, as long as it can output HTML formatted pages.

b. Web Page and Public Directory

The web page must be uploaded to a publicly accessible directory. Uploading is the act of taking data from a personal computer system and casting (or launching) it to the WWW. Note: the designer must have an Internet service account that supports large amounts of data, since large amounts of data will be uploaded to the designers public account. Thus, the designer must have a network account that supports (and allows) the designer to upload hundreds of megabytes of data. The exact amount of memory required in a designers network account is dependent on configuration settings and length of data to be uploaded. Nonetheless, even a small number of video clips with

low configuration settings will require more storage space than typical Internet service providers will allow (e.g., AOL, Prodigy, Microsoft). Most of these commercial services only allow up to 10 megabytes of data in a customer account. See Section D of Chapter VI.

c. Uploading Individual Video Clips

When the web page is uploaded, the author must then upload the individual video clips. Appendix B, Section J provides a detailed narration of the steps necessary to perform this procedure. This process offers the user another alternative for observing the security lecture.

H. OTHER ISSUES

At this point the process is complete. There are, however, other issues discussed in Appendix B that are not considered in this Chapter (e.g., how to read the CD production using the Web format on either a Mac or PC). An important result of this work is the tutorial of Appendix B. The tutorial describes the appropriate application and documentation of existing HW/SW to transform the lectures into new formats.

VI. AUDIO ISSUES AND EXPERIMENTATION WITH SOUNDHACK

A. PREFACE

As alluded to in Chapter III, one of the primary issues that the designer must consider is the actual quality of the product. Also mentioned in Chapter III, is the fact that, for various reasons, video taped productions will not always possess acceptable audio quality. If this is the case, the first step is to attempt to fix the audio problems with the tools provided in Media 100. Media 100, however, has rather limited resources for correcting audio deficiencies. When Media 100 can not solve audio problems, the designer must turn to software dedicated to audio processing.

B. SOUNDHACK

SoundHack is a soundfile processing program for the Macintosh systems. It performs many utility and sound processing functions.

Specifically, SoundHack performs:

- Time stretching or pitch shifting with the Phase Vocoder.
- Cross-synthesis between two soundfiles with Spectral Mutation.
- Noise reduction, spectral expansion or compression with the Spectral Dynamics processor.
- Separate transient and steady-state components with the Spectral Extractor.
- Gain factoring for channels via Gain Change

SoundHack's utility functions allow the designer to:

- Play most soundfiles (including AU, AIFF and WAVE).
- Record any size soundfile from the Macintosh sound input.
- Import soundfiles from audio CDs.

As mentioned in Chapter IV, SoundHack is being employed to sample audio quality via spectral extraction, spectral mutation, spectral dynamics processing, phase vocoding, and gain changes. Purpose: to explore various SoundHack functions to mitigate different factors leading to poor sound quality. Using the same (sample) audio clip, the effect of each sound processing function will be tested, analyzed, and documented.

In order to achieve good analysis from each sound processing function, some ground rules need to be defined. First, the audio clip sample used will be one of poor quality. This will make it easier for the designer to discern changes (positive and negative) between the sample clip and the processed clip. The sample clip used was a 30 second clip from a lecture by Dr. James Anderson.

Second, a set of audio qualities must be defined for analysis. The following audio qualities used in this study are:

- Background Noise - other environmental sounds that are not derived from the lecturer which detract from the brief
- White Noise - electronically derived sounds which detract from the brief
- Inflection - How well the lecturer's voice carries
- Clarity - How clear and understandable the lecturer's content is
- Volume - the degree of loudness or intensity of the lecturer

Third, multiple tests must be performed for each sound processing function in order to derive some conclusion about the advantages, disadvantages, or neutrality associated with the particular function being analyzed.

Fourth, tables will be derived to allow the reader to make comparisons among the various audio processing options effect on the sample clip. Therefore, a scale must be

developed to show the effect. For the purpose of this thesis, the scale will range from -5 to 5. Figure 5 gives a graphical interpretation.

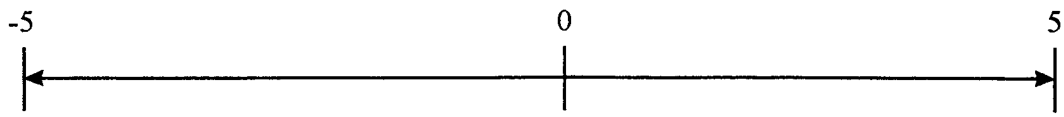

Figure 5: Graphical Interpretation of Audio Quality Algorithm

On this scale, zero represents the base case. All audio qualities from the original sample clip will be set to zero. Any degrading effects the sound processing functions have on the sample clip will be designated by the values -1 to -5, -5 being the highest negative effect. Any improvements the sound processing functions have on the sample clip will be designated by the values 1 to 5, 5 being the highest positive effect.

C. SPECTRAL MUTATION FUNCTION

The Spectral Mutation Function allows the user to select between seven different mutation functions. They are:

- USIM (Uniform Signed Interval Mutation)
- ISIM (Irregular Signed Interval Mutation)
- IUIM (Irregular Unsigned Interval Mutation)
- UUIM (Uniform Unsigned Interval Mutation)
- LCM (Linear Contour Mutation)
- LCM/IUIM
- LCM/UUIM

The seven spectral mutation functions produce different types of timbral cross-fades. Each mutation takes 2 soundfiles: a source (the sample clip) and a target (a clip previously produced, saved, and designated by the designer). After cross-fading the soundfiles, this function returns a third soundfile, called the mutant. The mutation functions operate on the phase/amplitude pair of each frequency band of the source and

target spectra[3]. The end result (mutant soundfile) is a phase/amplitude pair for each frequency band in the mutant soundfile. Table 1 displays the effects that the different mutation functions had on the sample clip.

	Background Noise	White Noise	Inflection	Clarity	Volume
USIM	**0**	**-3**	**-4**	**-4**	**0**
ISIM	+2	+3	**-1**	**-2**	**-3**
IUIM	**0**	**-1**	**0**	**-1**	**0**
UUIM	+2	+4	**-3**	**-3**	**0**
LCM	**0**	+1	**-1**	**-1**	**0**
LCM/IUIM	+2	+3	**-2**	**-2**	**-1**
LCM/UUIM	**-2**	**-1**	+2	+1	+1

Table 1: Mutation Effects on Sample Clip

Analysis of each mutation function provides interesting results. Overall, there appears to be either negative effects, no major effects, or tradeoffs to the audio qualities. USIM was the only function to negatively effect most audio qualities. IUIM and LCM did not have a big impact on the sample clip. ISIM, UUIM, LCM/IUIM, LCM/UUIM all displayed tradeoffs in sound quality. Each of the functions that displayed tradeoffs all had another interesting aspect. The functions that decreased background and white noise also

decreased inflection and clarity. Finally, none of the functions made an increase in the overall audio quality of the sample clip.

D. SPECTRAL DYNAMICS FUNCTION

Spectral Dynamics Function performs standard dynamics processing (gating, expansion, compression) on each spectral band individually. This function is useful if there is a sound that one wants to emphasize or de-emphasize.

This process has many options. The first option allows the designer to select either the gating, expansion, or compression dynamics processing. The second option sets the number of filter bands (e.g., 256, 512, 1024) to separate the sound. The third option, the Gain/Reduction Box, permits the designer to set the amount of gain or reduction for the bands which are past the threshold. Table 2 displays the effects that the different spectral dynamics options had on the sample clip. For this table, Band and G/R represent the options two and three respectively.

	Background Noise	White Noise	Inflection	Clarity	Volume
Gating Band: 1024 G/R: -40.000	**0**	**0**	**0**	**0**	**0**
Gating Band: 512 G/R: -40.000	**0**	**0**	**0**	**0**	**0**
Gating Band: 2048 G/R: -40.000	**0**	**0**	**-1**	**-1**	**-1**
Gating Band: 1024 G/R: -20.000	**0**	**0**	**-1**	**-1**	**-1**
Gating Band: 1024 G/R: -60.000	**0**	**0**	**0**	**0**	**0**
Expansion 1:1 Band: 1024 G/R: -40.000	**-1**	**-1**	**+1**	**+1**	**+1**
Expansion 1:1 Band: 512 G/R: -40.000	**-1**	**-1**	**+1**	**+1**	**+1**
Expansion 1:1 Band: 2048 G/R: -40.000	**-1**	**-1**	**+1**	**+1**	**+1**
Expansion 10:1 Band: 1024 G/R: -40.000	**-2**	**-2**	**+3**	**+1**	**+4**
Expansion 10:1 Band: 512 G/R: -40.000	**-2**	**-2**	**+3**	**+1**	**+4**
Expansion 10:1 Band: 1024 G/R: -60.000	**-2**	**-2**	**+3**	**+1**	**+4**
Compression Band: 1024 G/R: -40.000	**-2**	**-2**	**-5**	**-5**	**-1**
Compression Band: 2048 G/R: -40.000	**-2**	**-2**	**-5**	**-5**	**-1**

Table 2: Spectral Dynamics Effects on Sample Clip

Looking at Table 2, some observations can be made. When in gating mode, there appears to be little effect on the sample clip. Note: when the Band and G/R are adjusted, none of the audio qualities change significantly, if at all. Expansion, especially at a higher ratio, has significant effects on the audio characteristics. Expansion also has tradeoff issues similar to those in the Mutation Function. However, unlike the Mutation Function, Expansion (at the higher ratio) improves the overall audio quality of the sample clips. Finally, compression appears to only negatively effect the sample clip.

E. PHASE VOCODER

The Phase Vocoder allows the user to change pitch without changing the length of the sample clip (or to change length without changing pitch). It does this by extracting amplitude and phase information from frequency bands with a bank of filters.

The Phase Vocoder has three main option settings. The Bands option sets the number of filter-oscillator pairs (e.g. 512, 1024, 2048). A large bands setting will give better frequency resolution, while small bands will give better time resolution. The Overlap option adjusts the size of the filter window for sharpness of the filter. There are four settings in the overlap option (.5x, 1x, 2x, 4x). A large setting (4x) will give the sharpest filter. A sharper filter differentiates better between frequencies which are between bands, but responds to amplitude changes slower[3]. The Pitch Scale option allows the user to increase or decrease the pitch on frequency bands. Table 3 displays the effects that the Phase Vocoder options had on the sample clip. For this table the overlap option will be represented by OO and PS will represent the pitch scale option.

	Background Noise	White Noise	Inflection	Clarity	Volume
OO: 1x Band: 1024 PS: 1.0000	**0**	**0**	**0**	**0**	**0**
OO: 2x Band: 1024 PS: 1.000	**0**	**0**	**0**	**0**	**0**
OO: 4x Band: 1024 PS: 1.000	**+1**	**+2**	**-1**	**-3**	**-3**
OO: 2x Band: 2048 PS: 1.000	**0**	**0**	**0**	**0**	**0**
OO: 2x Band: 512 PS: 1.000	**0**	**-4**	**-3**	**-4**	**-3**
OO: 2x Band: 256 PS: 1.000	**0**	**-5**	**-5**	**-5**	**-4**
OO: 2x Band: 1024 PS: 1.2500	**0**	**-3**	**+1**	**-4**	**0**
OO: 2x Band: 1024 PS: 1.5000	**0**	**-5**	**+1**	**-5**	**0**
OO: 2x Band: 1024 PS: 1.75	**0**	**-5**	**+1**	**-5**	**0**

Table 3: Spectral Dynamics Effects on Sample Clip

Again, analysis of Table 3 provides some interesting points. When adjusting the Overlap option, while maintaining the default settings on the other two options, it appears that the highest setting does decrease the background and white noises. However, it has a negative effect on the other audio qualities, and overall audio quality is degraded. The Band option does not appear to have an effect on the audio qualities when increased, but displays significant negative effects when decreased. Increases in the Pitch Scale setting

minimally increase the inflection, while significantly decreasing white noise and clarity. Finally, none of the options made an overall improvement on the sample clip's audio quality.

F. GAIN CHANGE

The primary function of Gain Change is to allow the user to select a different gain factor for each channel. If the user inputs a monaural file, then only the channel 1 information is processed. Media 100 automatically processes binaural files.(in this case Channel 1 and Channel 2). When processed, Change Gain will create a new file adjusted by the gain factors set. Table 4 displays the effects that Gain Change had on the sample clip.

	Background Noise	White Noise	Inflection	Clarity	Volume
Ch 1: 12.3093 Ch 2: 0.000 Default Values	**0**	**0**	**0**	**0**	**0**
Ch 1: 12.3093 Ch 2: 1.000	**0**	**-1**	**0**	**0**	**0**
Ch 1: 12.3093 Ch 2: 5.000	**-1**	**-2**	**-1**	**-1**	**0**
Ch 1: 12.3093 Ch 2: 10.000	**-2**	**-2**	**-2**	**-2**	**0**
Ch 1: 12.3093 Ch 2: 20.000	**-3**	**-3**	**-3**	**-4**	**0**
Ch 1: 18.3093 Ch 2: 0.000	**0**	**0**	**-1**	**0**	**-2**
Ch 1: 15.3093 Ch 2: 0.000	**0**	**0**	**0**	**0**	**0**
Ch 1: 10.3093 Ch 2: 0.000	**0**	**-5**	**-2**	**-4**	**3**
Ch 1: 8.3093 Ch 2: 0.000	**0**	**0**	**0**	**0**	**0**
Ch 1: 5.3093 Ch 2: 0.000	**0**	**0**	**0**	**0**	**0**
Ch 1: 10.3093 Ch 2: 5.000	**0**	**-1**	**-1**	**-1**	**0**
Ch 1: 8.3093 Ch 2: 7.000	**0**	**-1**	**-1**	**-1**	**0**
Ch 1: 5.3903 Ch 2: 9.000	**0**	**-2**	**-2**	**-3**	**-1**

Table 4: Gain Change Effects on Sample Clip

This table is a bit more difficult to analyze as some of the patterns are irregular. One observation is that when Channel 1's gain factor is kept at the default setting of 12.3093, and Channel 2's gain factor is increased, overall sound quality decreases. Another interesting point is that when Channel 2's gain factor is kept at the default setting of 0.000, and Channel 1's gain factor is adjusted, no clear pattern was displayed. Also, as the gain factor of Channel 2 approaches and surpasses that of Channel 1, overall audio quality steadily decreases. Finally, none of the Gain Change samples made an overall improvement on the sample clip's audio quality.

G. SPECTRAL EXTRACTION

The Spectral Extraction Function attempts to separate the stable (pitched) and transient (unpitched) parts of a sound by measuring the speed of frequency deviation. If the deviation is too quick, it is marked unpitched information and output to the transient soundfile[3]. If it is too stable, it is marked pitched information and output to the stable soundfile. The user can control this separation via a Bands pull down menu of this function.

The user can also set the number of Frames. Setting the number of Frames permits the user to set the size of the analysis frame. This frame should be set this higher when there is difficulty separating the stable (pitched) material, and lower when there is difficulty separating the transient (unpitched) material.

Further, this function provides two frequency values (one for transient, one for stable) that the user may adjust to specify the amount of change allowed during each analysis frame.

No table is required for this function. Multiple tests were attempted, each time adjusting one or more of the option settings. None of the tests provided any change (positive or negative) to the individual or overall quality of the sample clip.

No analysis can be derived, since no changes took place. However, it can be noted that, perhaps, this function works to improve an audio problem that does not exist in the sample clip. Further, the designer may have input values that were "out of bounds" or not understood by this function. Since multiple tests were performed with this function, the author believes the former was the problem.

H. DISCUSSION

The results of this chapter proved to be very successful. The goal was to use the various functions of SoundHack on a sample clip, document the changes, and analyze the effects (positive and negative). Almost every function attempted provided changes to the sample clip that could be documented and analyzed. Although many changes were negative changes, they introduced many positive concepts. They are:

- SoundHack does work on the audio clips that Media 100 digitizes
- SoundHack provides a base for documentation of soundfile improvement
- SoundHack provides a base for analysis of soundfiles
- SoundHack may be the answer to poor audio quality. This exercise only tested a sample of SoundHack's potential configuration settings. In that sample, some analysis proved to have positive overall effects. Hence, further testing may provide better results and potential answers to poor sound quality.

VII. LESSONS LEARNED

A. PREFACE

Any time a new idea is implemented, there will usually be bumps in the road. This undertaking was not an exception to the rule. This effort has witnessed its share of issues to be resolved. The following chronicles some of the key lessons learned and the proposed solutions.

B. VIDEO TAPE PRODUCTION

Video taping a lecture is the foundation of the product. The quality of the product is directly proportional to the quality of the original video taped lecture. Once the original tape is recorded, little can be done to improve poor visual effects.

Proper lighting is crucial to a good production. It is important that the camera person set the equipment up well in advance to allow for a few practice takes before the lecture. This, in turn, permits adjustments in lighting.

Sound is another critical element in the video taping process. The equipment is usually more than twenty-five feet away from the speaker. Therefore, some of the primary issues that will arise with sound are background noise, white noise, and speakers with soft voices. Two ways to avoid these problems are to either hard-wire a microphone into the camera, or acquire a wireless microphone and mount the receiver on the camera.

The camera person should review the lecture with the briefer. Knowing the content of the brief, the style of the briefer, and what types of visual aides the briefer will be employing is valuable to a good video taping session. This assures there are no surprises, and provides the camera operator with a mental picture of what to expect.

C. DIGITIZING PROBLEMS

Before attempting to digitize, two steps are required. First, a backup copy of the original video should be made. The importance of backup can not be overstated. Second, the tape should be reviewed. When viewing the video, draw up an outline of the content. This aids in the follow on procedures and provides an excellent structure for CD production and web launching.

Digitizing demands a large amount of system memory – due to the source graphics generate. An hour long video will require 10 or more gigabytes of hard drive space (this assumes a minimum of 8 frames per second, the lowest frame count setting for video in Media 100). If a higher frame rate is desired, even more memory is needed. This is a big problem for systems with limited memory (or systems with multiple users).

When digitizing, if the lecturer makes use of numerous slides, graphics, and visual aids, the video option in the Edit Suite Window can be turned off (See Figure 4). This will render only the digitized audio. Its associated slide or graphic will be incorporated prior to exporting. Since the implemented visual aid will not require movement, only one frame per second needs to be exported. This option alone will reduce the amount of memory required and download time by more than fifty percent.

Further, from a designer's perspective, video taped lectures should be digitized, edited, and exported one clip at a time. This conserves hard drive memory at each stage of the process. When a digitized clip is completely edited and exported, the video source associated with that clip can be deleted. Thus, if memory conservation is a concern, this technique will support the production of lengthy security lectures in multiple phases. Note: When the video source is deleted, CDs can be recorded and clips can be uploaded

to web pages. However, the clips can no longer be revised unless re-digitized. The user should be careful to ensure the clip is complete before deleting the video source.

D. EXPORT SUITE OPTIONS

Most of the video and audio options for Media 100 are handled when exporting. This makes the exporting phase of this study an excellent place to research and decide the tradeoffs between memory conservation and clip quality. Note: Memory conservation can be objectively monitored. For example, take a sample of video, say 30 seconds. This same 30 second video sample can be digitized using a full, half and quarter frame. With all other configuration settings being the same, the memory consumption differences between the three samples can be objectively monitored. After obtaining the differences, further multiplication by the length of the entire lecture will provide an objective figure as to how much memory will be required. For instance:

- 30 sec clip at Full Frame = 200MB * 45 minutes lecture = 9 gigabytes
- 30 sec clip at Half Frame = 100MB * 45 min. lecture = 4.5 gigabytes
- 30 sec clip at Quarter Frame = 50MB * 45 min. lecture = 2.25 gigabytes

Equations like these can be applied toward all video and audio options to obtain objective result for the designer to monitor. Clip quality, on the other hand, is somewhat subjective.

The author bases clip quality on:

- audio clarity
- video clarity
- presence or absence of background noise
- presence or absence of white noise
- video color
- audio inflection
- audio volume
- video transitioning (i.e., is the video chopping)

When the designer deems it is the right time to export a clip, or an entire production (after digitizing and editing), a dialog box (shown in Figure 5) will pop up.

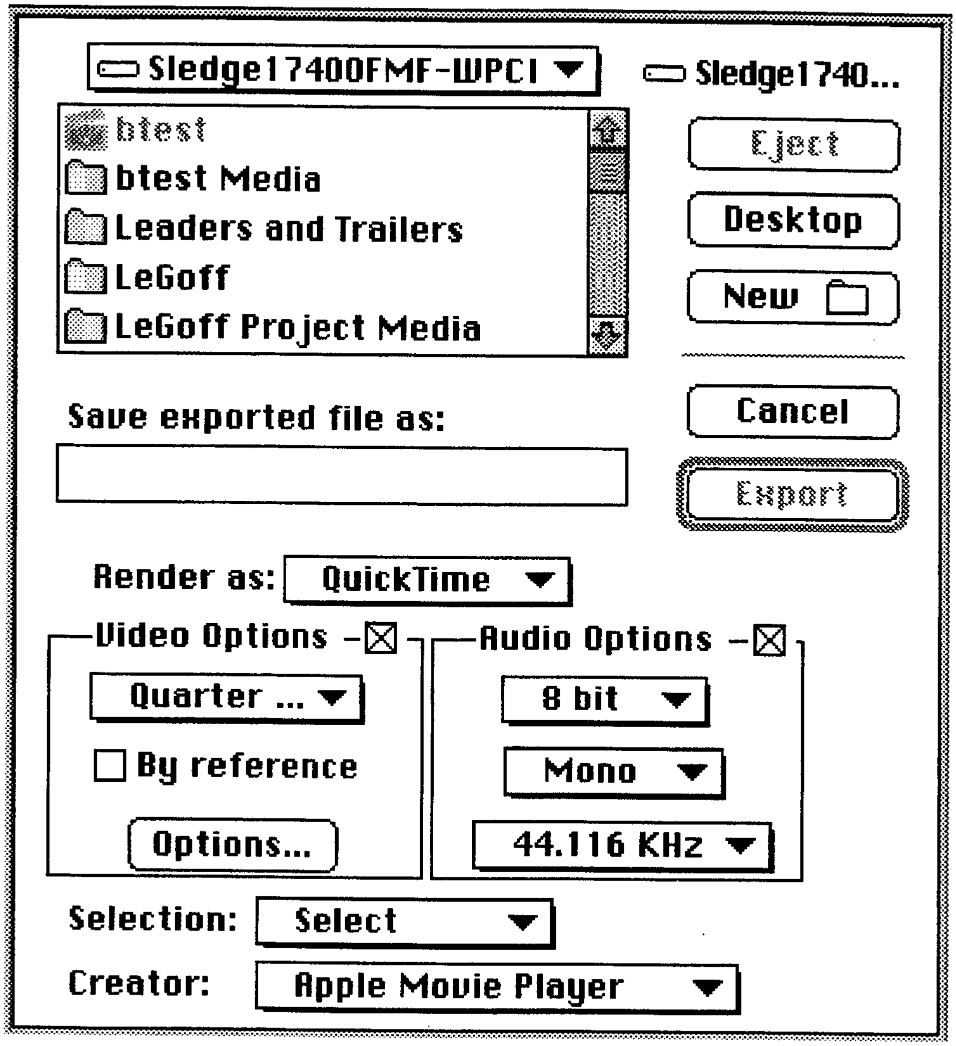

Figure 5: Export Options Dialog Box From Ref. [7].

This dialog box provides multiple options for the designer to create a production which conserves memory, decreases download time, offers excellent audio and good video.

1. Video Frame Size

Referencing the Video Options box of Figure 5, there is a Frame Size pull-down menu. Options for this pull-down menu include Full Frame, Half Frame, and Quarter Frame. Prior to exporting any video, this pull down menu should be set to Quarter Frame. A Quarter Frame provides the user with an ample visual aid when listening to a lecture. Further, it requires only fifty percent of the local memory that a Half Frame needs, and only twenty-five percent of the memory a Full Frame demands. These numbers work in the opposite direction for end-users. In other words, the user will require fifty and twenty-five percent less time to download the product, respectively, when the product is exported with the Quarter Frame setting.

2. Audio Options

Referencing the Audio Options box in Figure 5, there are two pull-down menus. The top pull-down menu offers 8 and 16 bit audio quality. The bottom pull-down menu offers mono and stereo options. The combination of options for this box are 8 bit mono, 8 bit stereo, 16 bit mono, and 16 bit stereo. Testing proved that the combination of 16 bit mono is the best choice for audio. The audio clarity of 16 bit quality over 8 bit is clearly worth the extra memory required. Stereo effects, however, do not provide a noticeable improvement (in clarity) over mono. Hence, they do not warrant the extra cost in memory.

3. Compression Options

The Video Options box (shown in Figure 5) also grants the designer a Compression Options checkbox. When this box is selected a dialog box similar to the following pops up.

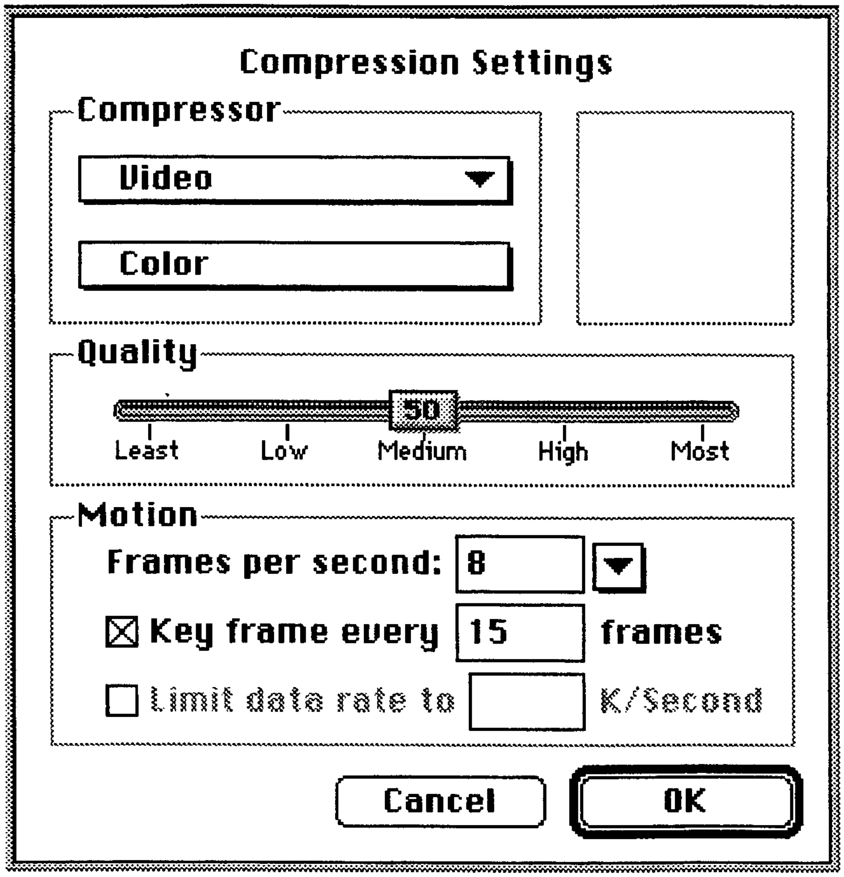

Figure 6: Compression Settings Dialog Box From Ref. [7].

Referring to the Compressor box of Figure 6, there are two pull-down menus (the CODEC pull-down menu and the Pixel depth pull-down menu, respectively). When the CODEC pull-down menu is selected, the designer is offered 14 different compressor types as depicted in Figure 7 below. The designer must choose the best compressor based on quality and conservation. Given that, a test was performed on the same ten second quarter frame video clip. For this test all other configuration settings were equal. Table 5 displays the results of this test.

Compressor Type	Size in MB
animation.mov	1.5
cinapak.mov	1
componentvid.mov	1
graphics.mov	2.6
HDR.mov	3.4
intelindeo.mov	1
intelraw.mov	1.8
jpega.mov	1
jpegb.mov	1
media100.mov	3.4
none.mov	1.5
photojpeg.mov	1.3
planarRGB.mov	1.5
video.mov	1

Table 5: Compression Test Results

Observing Table 5, its noted that none of the compressor types required less than 1 MB of memory. Six of the compressors are tied for the lowest memory usage with only 1 MB. Thus, the designer will want to choose one of these six, provided its quality is adequate. Based on this project's requirements, the "video" proved to be the best compressor choice. Its quality (based on the authors precept's for quality) is equal to or greater than all other compressors; while its memory usage is equal to or less than the same. When "video" is chosen, the Pixel depth pull-down menu defaults to "color".

Referring again to Figure 6, there is a Motion box. Within this box there is a "Frames per second" pull-down menu. As its name indicates, the frames per second (fps) pull-down menu allows the designer to decide how many frames per second will be exported. The range of this menu is 8 to 29.97. This menu should be set to 8 fps. The 8

fps option is chosen because it maintains the quality of quarter frame video, and conserves drive space. For example, 16 fps would require two times more memory than 8 fps. This can not be the setting for all video. For example, if the video that has been obtained contains substantial movement by the speaker, the 8 fps option would degrade the quality because 8 fps is not a high enough setting to sufficiently display substantial movement. However, since lecturers do not normally make substantial movements, the quality is not significantly effected.

Also in the Motion box is a "Key frame field". The Key frame field refreshes the overall exported video. The word "refresh" basically means to clean up the moving video. As the digitized video moves from frame to frame it can become choppy and distorted (especially at low fps settings). A refresh frame uses a "timecode" to calculate what the video should look like at a particular frame. At the Key frame the video is refreshed. This field should be set to 16. Therefore, with 8 frames per second exported, and a Key frame every 16 frames, the entire picture will be refreshed every 2 seconds.

$$\frac{\text{key frame every 16 frames}}{\text{8 frames per second}} = \text{refresh frame every 2 seconds}$$

E. WEB LAUNCHING CONCERNS

When it is time to upload the clips to the WWW, the designer must have an account set up which supports this massive upload. For the sake of this study, the average security lecture will be 50 minutes in length. This will generate approximately 500 megabytes of data to be uploaded to the Internet (this does not include the source from digitizing). A typical commercial web site (e.g., AOL, Prodigy, etc.) will not support an upload of this magnitude for an individual user account. The designer must have access to

a dedicated server which will support large uploads (corporate, university, government, etc.).

Another concern is that Internet download times can be lengthy. Streaming technologies are designed to overcome the fundamental bandwidth problem facing multimedia elements distributed over the Web[10]. A 33.6-kbps modem or 128-kbps ISDN connection seem very fast. However, they are extremely slow when compared to modern CD-ROM drives. Even an older single-speed CD-ROM drive can transfer 150K of data each second. Therefore, the throughput of a 28.8-kbps modem is approximately 1/40 the speed of a single speed CD-ROM drive. Imagine the difference when considering a 16 speed CD-ROM.

One way to circumvent the extensive download time is via embedding (or prefetching). This is the process of downloading all the clips prior to viewing them. This process requires embedded code. The embedded code automatically downloads the rest of the links on the HTML page after the first link (clip) is selected. This does not relieve the user of lengthy downloads, but does allow the user to step away from the system during the download period.

Compression helps the process of sending video over the Internet, but it is not a cure. If the user attempts to access video clips via the Internet while employing a 28.8-kbps modem, and selects a clip with 10 megabytes of data, the download time will exceed 30 minutes. This is contrary to the goal of keeping the audience interested in these security lectures. Hence, it seems that in the near future no compression will achieve this target without fundamental changes in the communication bandwidth. At this point, increasing the bandwidth is possible in several ways. All of them are expensive.

- Replacing the analog phone lines with ISDN lines that provide a 128-Kbps bandwidth, more than 4 times the fastest modem.
- Large organizations can rent digital phone lines with a 256-Kbps to a 34-Mbps.
- In the near future we will use a cable modem that will be connected to the cable network and will use the high Coax cables bandwidth.
- In the far future we will use CyberOptics cables which in labs achieves bandwidth of billions bits per second and theoretically we are far from exploiting their potential[10].

For the most part, the suggestions above solve the bandwidth problem. Nevertheless, they introduce a new problem that this study is trying to avoid: high cost to the user. However, looking at past computers and communications technologies, history tells us the problem of cost often fixes itself. As the Internet grows in global size and bandwidth, and as computer technology increases in speed and drops in price, the Internet will become increasingly more feasible as a provider of these security lectures. Fast Internet connections (at reasonable prices) will soon bring low-cost, CD-quality telephony and high quality video to all Internet users. Remember, we are in the center of a technological revolution, but only at the very beginning of a revolution in computer communications. Video on the Internet will get better, faster, and cheaper.

VIII. SUMMARY AND DISCUSSION

A. SUMMARY

More than any other time in history a strong understanding of computer security and its principles are vital to sound computing practice. Unfortunately, most people are more concerned with performance, flexibility, and cost than they are with security. Something must be done to make security awareness convenient and inexpensive to the end-user.

The purpose of this study was to research and develop a tool which could mass disseminate multiple formats of video taped security lectures in a convenient and cost effective manner to the end-user. As witnessed in the previous chapters, the right combination and application of existing hardware and software coupled with multimedia tools can yield a product which develops and mass distributes security lectures to interested government, non-government, academic, and industry organizations.

The successful completion of this study provides end-users with multiple formats for viewing said security lectures, thus, providing a more security aware computing and communication environment. Further, referring to Appendix B, it provides a tutorial for reproducing the desired effect of this study.

The Lessons Learned Chapter of this study suggests a problem in the overall desired effect of this study. While video taped and compact disk reproduction of the security lectures appears to be a viable option for mass distribution, currently, HTML content does not. As mentioned earlier, this study must assume the end-user can view the security lectures via COTS products. This philosophy works well for the end-users who

want to view the lectures with VCR's and CD-ROM drives. However, the end-user who wants to view the lectures via HTML content will typically use a 28.8 or 33.6kbps modem. The average size of video clips uploaded to the Internet (by the designer) currently require too much download time for end-user convenience. Therefore, more work needs to be accomplished in this area to obtain a the complete desired effect of this study.

B. SUGGESTIONS FOR FUTURE RESEARCH

This thesis laid the groundwork for the future of mass distribution of security lectures. However, there are still more areas of research and development to be performed. The following sections describe areas that can be researched to improve the product.

1. Work within Media 100

Media 100 is a sophisticated software tool as evidenced by its users manual which is 714 pages in length. There is a large number of editing options which were not explored in this thesis, and further research into these could increase the quality of the product for the end-user. Once the future designer is comfortable with the tutorial provided in Appendix B, other areas can be researched (color effects, dissolving effects, overlaying, etc.) for a better overall result. This could make the product more desireable to the end-user.

2. Work with Bandwidth

As mentioned in the Lessons Learned Chapter, bandwidth is the biggest limiting factor when trying to send video and graphics over the Internet. Currently, most people use 4 kHz phone lines, which where originally set up as a courier for human voice. While

excellent couriers for human voice, phone lines fall far short in performance when attempting to transport large data files of video and graphics over the Internet.

Also mentioned in the Lessons Learned Chapter are methods to increase bandwidth in the near and far future. However, all of these methods are expensive. Research and development may be able to find either alternative methods to increase bandwidth, or discover ways to make the suggested future methods less expensive.

3. Indexing

It may be possible to develop a mechanism which takes the voice from a compact disk or HTML content and transforms it into ASCII text (or a transcript of the lecture may be used). The text could then be sent through an algorithm which cuts out common words from the text (e.g., of, the , about, a, an). Once this process in complete, another algorithm could exist which allows the end-user to filter through the rest of the text to delete the remaining ineffectual content (e.g., something like the grammar tool in Microsoft Word). At this point, there would be a list of key words and key phrases. A third algorithm might exist which could create associations between the key words and phrases and the specific segments on the disk where they are used, and/or associated hyperlinks for web content. The end result could be a device which indexes the key words and phrases of the compact disk or HTML lecture so the end-user will be able to directly access specific words, phrases, or sections of a security lecture.

4. Work with SoundHack

As witnessed in Chapter VI, SoundHack may be the answer for poor audio quality. However, also noted in Chapter VI, the surface of SounHack's potential has just been scratched. There is a great deal more testing, analysis, and documentation that can be

done. Discovering the potential of SoundHack may ensure the highest audio quality in the disseminated output, regardless of the aural quality of the video tape input.

LIST OF REFERENCES

1. Adobe Systems, *Adobe PageMill,* Adobe Systems, Inc., Seattle, WA, 1995-1997.

2. Astarte USA, *Astarte Toast CD-ROM Pro 3.0,* Astarte USA, San Francisco, CA, 1996.

3. Erbe, Tom, *SoundHack version 0.873,* Valencia, CA, 1996.

4. Garfinkel, Simson and Spafford, Gene, *Practical Unix & Internet Security, 2nd Edition,* O'Reilly & Associates, Inc., Sebastopol, CA, April 1996.

5. Lewis, Peter N., *Anarchie 2.0.1,* Stairways Shareware, Booragoon, WA, Australia1996.

6. Lipnack, Jessica and Stamps, Jeffrey, *Internet Worm c.1988,* Oliver Wight Publishing, Inc., New London, NH, 1995.

7. Multimedia Group Data Translation, *Media 100 User Manual,* Data Translation, Inc., Marlboro, MA, 1995.

8. Neumann, Peter G., *Computer Related Risks,* Addison Wesley Publishing Company, New York, New York, 1995.

9. Russell, Deborah and Gangemi, G.T., *Computer Security Basics,* O'Reilly & Associates, Inc., Sebastopol, CA, 1991.

10. Serber, Ron, Brosh, Eli, and Chaikin, Shlomy, *Video Over the Internet,* Uni Corporation, 291 Cleveland Street, Orange, NJ, 1996.

11. Seldes, George, *The Great Quotations,* New York, New York, Pocket Books, 1968.

12. Stallings, William, *Network and Internetwork Security,* Englewood Cliffs, NJ, Prentice-Hall, Inc., 1995.

13. Tanenbaum, Andrew S., *Computer Networks, 3rd Edition,* Prentice-Hall PTR, Prentice-Hall Inc., Upper Saddle River, NJ, 1995.

14. Vickers Benzel, Terry C., *SIGMA: Security and Interoperability for Heterogeneous Distributed Systems,* Trusted Information Systems, Inc., 1997.

15. Vickers Benzel, Terry C. and Sebes, Edward John, *Security for Distributed Object Interoperability Between Trusted and Untrusted Systems,* from the Proceedings of the National Computer Security Conference, Oakland, CA, 1994.

16. Wallace, Gregory K., *The JPEG Still Picture Compression Standard,* Communications of the ACM, Vol. 34, No. 4, 1991.

17. Williams, David B. and Webster, Peter R., *QuickTime 2.1 and MoviePlayer 2.1,* Schirmer Books, San Francisco, CA, 1996.

APPENDIX A. THE DISSEMINATED PRODUCT

A. PREFACE

The purpose of this appendix is to present the reader with examples of the text that will be shipped with the product medium (video tape, CD, Web content). This text will provide the users of the product with background for the information they are about to view. This ensures the user possesses the proper background to gain as much as possible from the lectures. These lectures can be viewed on the Internet at <http://www.npsnet.nps.navy.mil/umentum>.

B. SECURITY RISKS -- DR. PETER G. NEUMANN

1. About the Lecture

The serious problems in your life are never fully solved. If ever they should appear to be so, it is a sure sign that something has been lost. The meaning and purpose of a problem seem to lie not in its solution but in our working at it incessantly[8].

This quotation was not made by Dr. Neumann, however, it seems to embody the concepts presented in his book, *Computer Related Risks*, and this lecture.

During this lesson Dr. Neumann mentions that if your only tool is a hammer then everything looks like a nail, and that working in the computer security world for the greater part of his career, he tends to see everything as a risk.

This lecture represents a brief yet concentrated synopsis of the material covered in the previously mentioned book. Dr. Neumann presents keen insight as to why systems

fail presenting an overview and some interesting examples; the 1980 ARPANET problem, the AT&T Long Distance Outage, and the Ten State Outage. Each example offers the audience real evidence of computer security risks and problems.

Dr. Neumann continues with a discussion of accidental and intentional security risks. Then he covers a series of incidents; the Ballot Counting Case, the Air Traffic Outage, another ARPANET Case, and a Missile Launch Debacle. Instances of the tremendous problems and life threatening situations when there are holes in the security of system(s) are presented.

Dr. Neumann explains security requirements and the misconceptions associated with them. He examines some of the proposed solutions, such as firewalls, encryption, and security within operating systems. He believes each of these proposed solutions possess merit. Still, he does not see any of them as complete solutions. He notes that, others believe these are "enough" security to satisfy the needs of their respective organizations. Dr. Neumann views many of these proposed solutions as false senses of security. He clearly describes, even to the casual observer, the vast number of ways these security mechanisms can be defeated if not backed up with other security devices. He perceives, with a lot of evidence to back these perceptions, far too many case histories where security was handled with patches instead of thorough security engineering.

Dr. Neumann finishes his discourse by explaining the importance of viewing systems in the "large" instead of the "small" when dealing with security related issues. To look at systems in the small is to maintain a philosophy of weak, single scope, penetrable security mechanisms. He wants the audience to embrace a large stance when dealing with security. What does this mean? Basically, he sees security as a never ending process: as

long as there are security violations, there is room for improvement. He believes that we cannot just look at one security mechanism as a cure all (e.g. firewall). We must consider multiple techniques and mechanisms to adopt a "defense in depth" approach (i.e. employ multiple security approaches: firewalls + I/O devices + PGP). Further, he states that the importance of education and research can never be overstated. In a world where multiple users are being tied into one another (via the World Wide Web), where sensitive information (credit card numbers, bank statements, classified data, etc.) is passed over the Web with ever increasing frequency, and where bad people exist, security must always be the prevailing thought.

2. Related Topics of Interest

If you found this topic of particular interest you might wish to examine some of the following references as provided in Dr. Neumann's *Computer Related Risks* Book:

- Nathaniel S. Borenstein, *Programming As if People Mattered: Friendly Programs, Software Engineering, and Other Noble Delusions,* Princeton University Press.
- Steven M. Casey, *Set Phasers on Stun, and Other True Tales of Design Technology and Human Error,* Aegean Publishing Company.
- John Gall, Systemantics: *How Systems Work and Especially How They Fail,* New York Times Book Company.
- Ralph Nader and Wesley J. Smith, *Collision Course: The Truth About Airline Safety*, TAB Books.
- Ivars Peterson, *Fatal Defect: Why Computers Fail,* Random House.
- Charles Perrow, *Normal Accidents,* Basic Books.
- Henry Petroski, *To Engineer is Human: The Role of Failure in Successful Design*, Cambridge University Press.
- Steve Talbott, *The Future Does Not Compute,* O'Reilly & Associates.
- Lauren Wiener, *Computer Woes: Why We Should Not Depend on Software,* Addison-Wesley.
- National Research Council, *Computers at Risk: Safe Computing in the Information Age*.

C. CORBA AND THE SIGMA PROJECT - TERRY C. VICKERS BENZEL

1. CORBA

Terry C. Vickers Benzel is an employee of Trusted Information Systems (TIS). The lecture presented by her is two fold. She first briefed the Common Object Request Broker Architecture (CORBA), then moved into the SIGMA Project.

Ms. Benzel opens her brief by describing CORBA. She explains that CORBA grew out of the need for interoperability among the rapidly proliferating number of hardware and software products available today. Developed by the Object Management Group's (OMG), it is an outgrowth of attempts to achieve interoperable distributed computing. The framework of their standardization effort is an architecture for Object Request Brokers ORBs, which enable diverse applications to interoperate in a uniform, platform-independent manner. The ORB represents the middleware that establishes the client-server relationships between objects. Using an ORB, a client can transparently invoke a method on a server object, which can be on the same machine or across a network. In so doing, the ORB provides interoperability between applications on different machines in heterogeneous distributed environments and seamlessly interconnects multiple object systems[14]. Simply stated, CORBA allows applications to communicate with one another no matter where they are located or who has designed them. OMG's job is to define the standards for this distributed object computing.

At this point of the lecture Benzel points out the goals of the CORBA security effort as follows:

- Simplicity
- Consistency across distributed system
- Scalability
- Usability
- Flexibility of security policy
- Independence of security technology
- Application portability
- Interoperability
- Performance
- Object orientation
- Confinement to trusted core

Benzel proceeds with an in depth segment on the key features of CORBA security. These features are:

- Identification and authentication - to verify that principals and objects are who they claim to be
- Authorization - to decide whether principal or object can access an object
- Security auditing - to make users accountable for their security actions
- Communication security - to protect communications integrity and/or confidentiality
- Non-repudiation - to provide proof of data origin and/or receipt
- Administration - to define object security information and security policy

After describing CORBA's goals and key features, Benzel explains the way CORBA security works is through two "Main Functionality Levels". Level 1 carries a conformance specification that must support security unaware applications. It is an ORB-enforced invocation security. It handles message protection, simple delegation, and access control. Level 2's conformance specification, on the other hand supports security aware applications, while sustaining an administrative interface.

Benzel makes a special point to mention the Security Conformance Statement. This is a statement that each OMG-compliant secure implementation must include to

describe the product's supported security functionality. It outlines the vendors assurance argument that demonstrates product conformance to security policy. It further enumerates product configuration constrainsts to ensure security conformance.

Benzel moves into the Security Policy Reference Model that the ORB implements. This model defines:

- When clients may access an object
- What authentication of users is required
- What communication security is needed between objects
- What accountability is needed

The following figure illustrates the Security Policy Refererence Model.

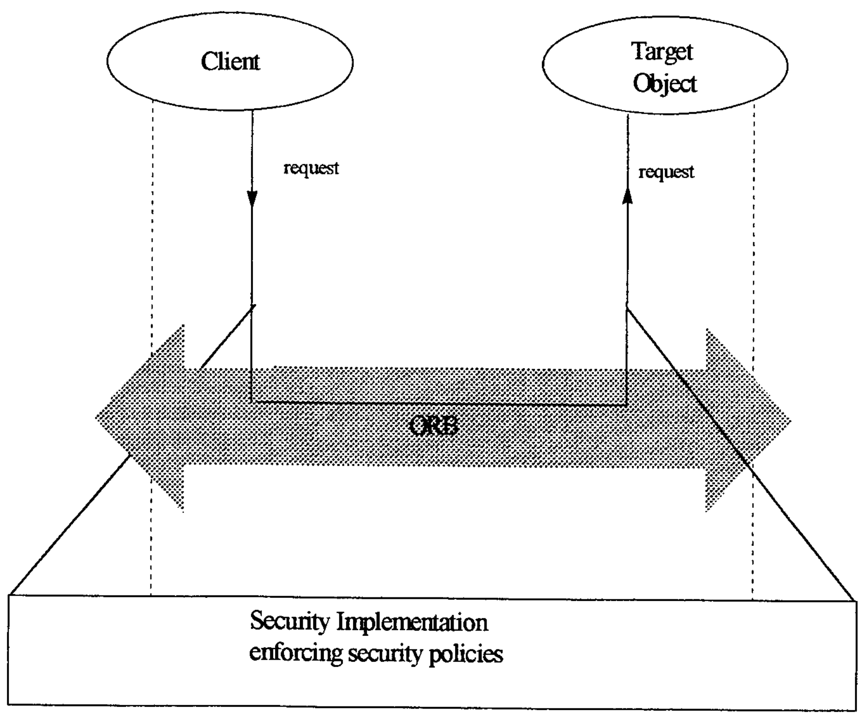

Figure 1: Security Policy Reference Model From Ref. [14].

After her discussion of the Security Policy Reference Model, Benzel transitioned into the Meta Model. The Meta Model rests on top of the Security Policy Reference

Model and defines a wide variety of security policies. A single security policy is not adequate as CORBA deals with government, industry, and commercial organizations.

The CORBA Meta Model must:

- Encompasses all possible supported policies
- Define abstract interfaces provided by security architecture to allow systems to support a policy
- Provides guidance on permitted flexibility of policy definition

The CORBA section of the lecture is completed with a discussion on the Interoperability Model. The Interoperability Model is how ORBs talk to ORBs. The three ways discussed to accomplish this model are:

- Interoperable Object Reference (IOR) with security
- Secure Inter-ORB Protocol (SECIOP)
- DCE Common Inter-ORB Protocol (DCE-CIOP) with security

2. The SIGMA Project

Benzel spends the remainder of the lecture discussing the SIGMA Project (Security and Interoperability for Heterogeneous Distributed Systems). This project is a three year research effort which explores the integration of security technologies into CORBA-based distributed computing. The three primary goals of the SIGMA Project are to ensure:

- Access control for interoperability between enclaves.
- High assurance security mechanisms for interoperability within an enclave.
- Support interoperation between trusted and untrusted enclaves.

According to Benzel the emphasis is on architectures and technologies that permit controlled and selective exchange of object-oriented services among enclaves which differ in security policy, mechanism, and assurance. This Inter-Enclave Security has three primary characteristics:

- High-assurance security mechanisms needed to ensure that outsiders may interoperate with the enclave only as authorized.
- Use of a network architecture to ensure the non-bypassibility of interoperability controls.
- Other enclave components may use additional security mechanisms to restrict access within the enclave.

The following illustrates the theoretical architecture for communication between heterogeneous enclaves.

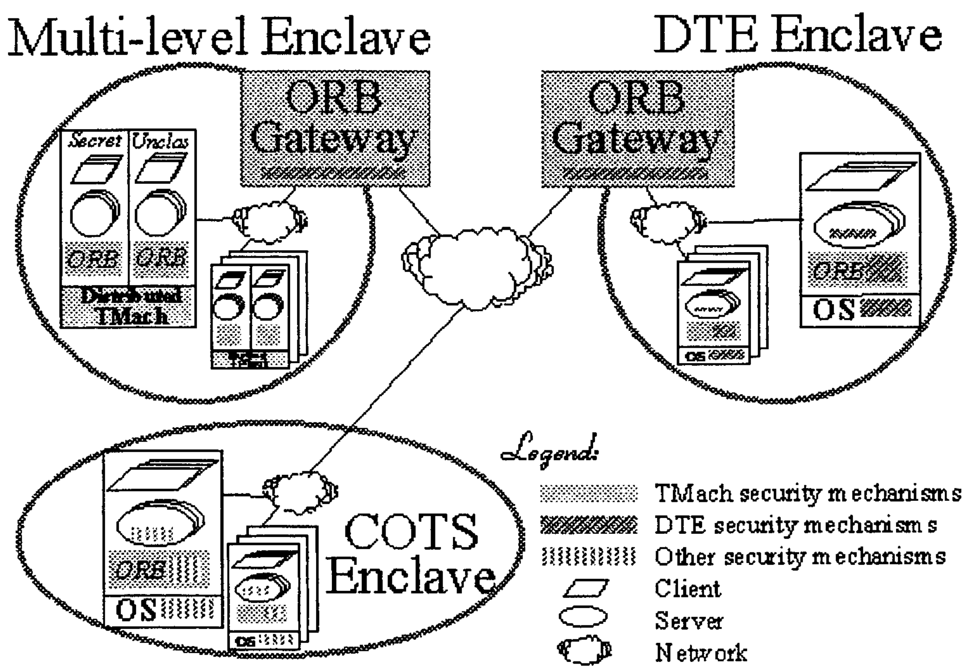

Figure 2: Interaction Between Heterogeneous Enclaves From Ref. [15]

Benzel continues with the discussion on Heterogeneous Enclaves by discussing ORB Gateways. ORB Gateways are a single point of external access to object services of an enclave. They mediate outside object requests based the nature of the request and attributes of the requester. Further information on ORB Gateways and ORB Gateway Access control are discussed in the lecture.

Benzel finishes the lecture with a brief discussion of the following areas:

- Domain Type Enforcement (DTE) for Object-Oriented Distributed Systems
- High-Assurance Interoperability within an Enclave
- CORBA-based multilevel security guards
- CORBA Guard Development vs Traditional Guard Development

3. Related Topics of Interest:

- Terry Vickers Benzel and Edward John Sebes, *Security for Distributed Object Interoperability Between Trusted and Untrusted Systems.* Located at http://www.tis.com/docs/research/distributed/sigpap. html
- Terry Vickers Benzel and Edward John Sebes, *Security for Distributed Object Interoperability Between Trusted and Untrusted Systems (slide show).* Located at http://www.tis.com/docs/research/distributed/acsac/index.htm
- *DARPA's Homepage* at http://www.arpa.mil/
- *DARPA/ITO's Homepage* at http://www.ito.arpa.mil/
- *Rome Laboratory's Homepage* at http://www.rl.af.mil/
- *Security and Interoperability for Heterogeneous Distributed Systems (slide show* at http://www.tis.com/docs/research/distributed/quorum/index.htm
- *CORBA/Firewall Security: Object Management Group Draft RFP (slide show)* at http://www.tis.com/docs/research/distributed/omg-austin/index.htm

APPENDIX B. TUTORIAL

A. CREATING A NEW PROJECT

1. Find the Media 100 application on the hard drive. Launch the Media 100 application by double-clicking on the icon.

2. After the application has started, go to the menu bar at the top and the screen and select "New Project…" from the "File" menu.

3. This will bring up a dialog box similar to the following:

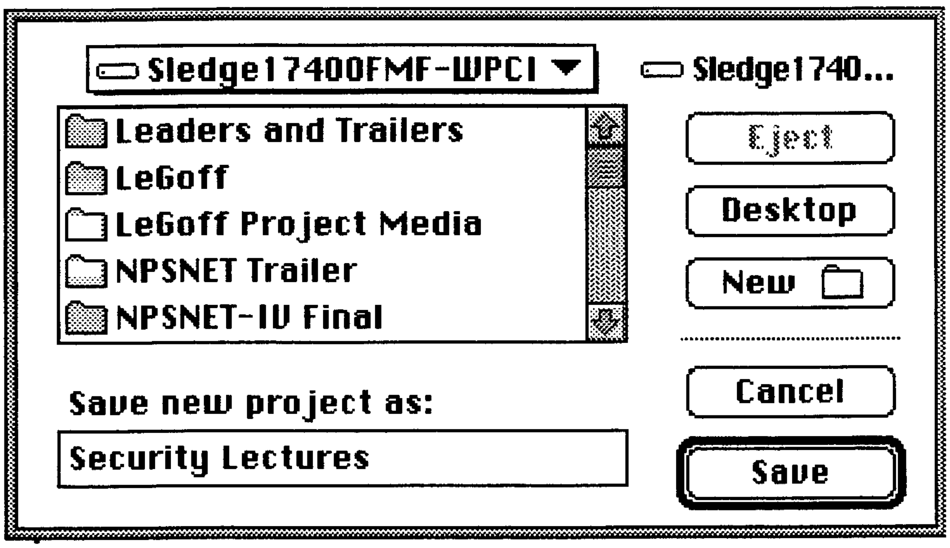

Figure 1: New Program Dialog Box From Ref. [7].

4. At the top of the dialog box is a pull down menu, which allows the user to move up in the file system, in order to save the new project. The user can also click on the "Desktop" button, which will bring them to the Desktop immediately. In this example, the new program will be saved on the hard drive named "Sledge 17400FMF-WPCI".

5. At the bottom on the dialogue is a text entry field for the user to name the new project. In this example the new project has been named "Security Lectures".

6. Once the name of the project has been entered, and the file listing window displays the place where the new project should be saved, the user then clicks the "Save" button.

7. The Project Window is now displayed. This window is used to display the Bins, which are collections of all of the media clips that the user digitizes. The function and usage of Bins will be discussed later.

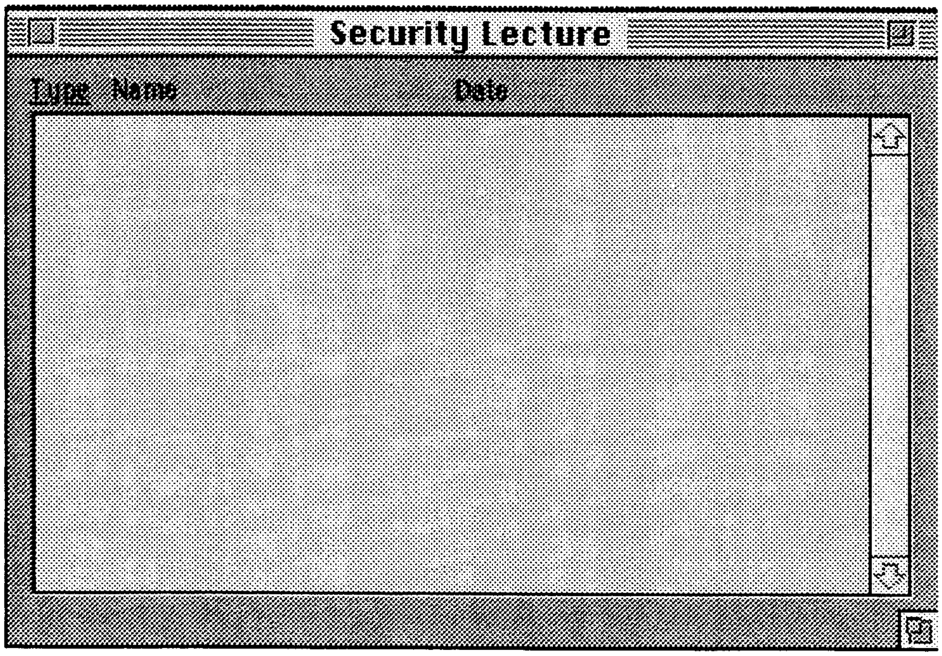

Figure 2: New Project Window From Ref. [7].

B. RE-OPENING AN EXISTING PROJECT

1. Find the Media 100 application on the hard drive. Launch the Media 100 application by double-clicking on the icon.

2. After the application has started, go to the Menu at the top and the screen and select “Open...” from the “File” menu.

3. This brings up a dialog box similar to that of Figure 1 (this dialogue does not have an text entry field at the bottom.)

4. Using the pull-down menu at the top of the dialogue box, select the hard drive that the file is stored on. Move down through the file system by selecting files or folders in the display window.

5. Once the project has been found and is viewable in the window, select it and hit the “Return” key.

6. The project will be opened to the last state that it was saved. All the windows will be displayed as the user left them.

C. OPENING THE EDIT SUITE WINDOW

1. This is the next step after opening or creating a new project.

2. Go to menu bar at the top of the screen and select “Edit Suite” from the “Tools” menu.

3. This will display a drop menu, from which the user selects “Digitize”. The following dialogue appears to the right of the Project Window.

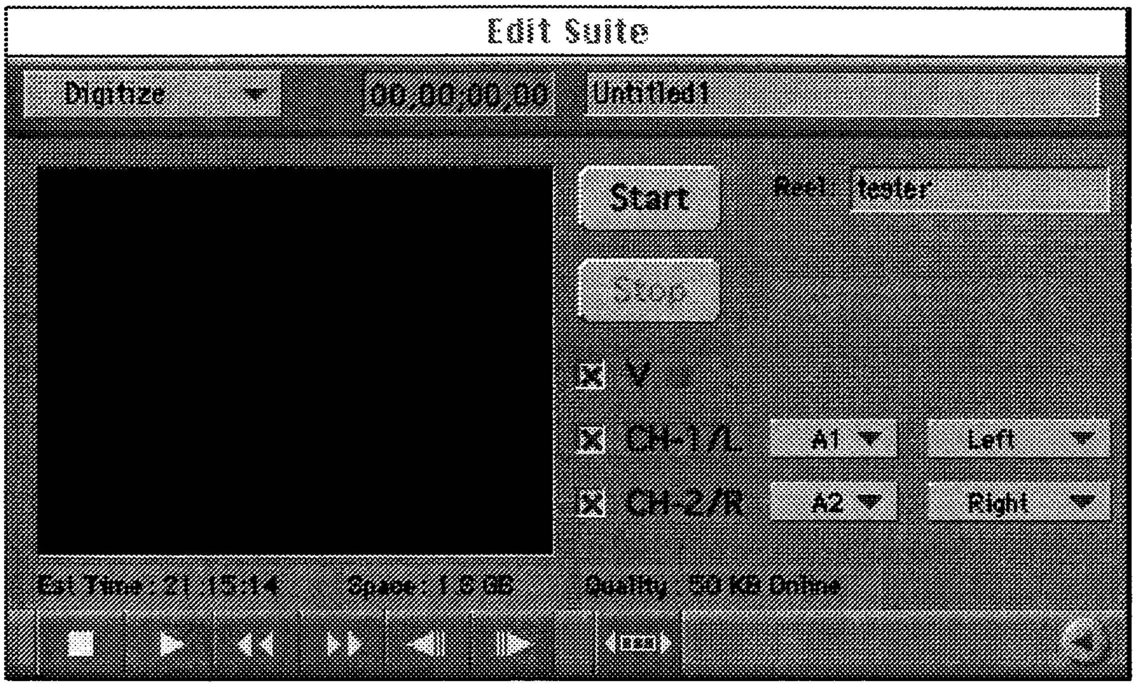

Figure 3: Edit Suite Window From Ref. [7].

4. The structure for the users new project is finished. The windows should appear on the screen as follows, in Figure 4:

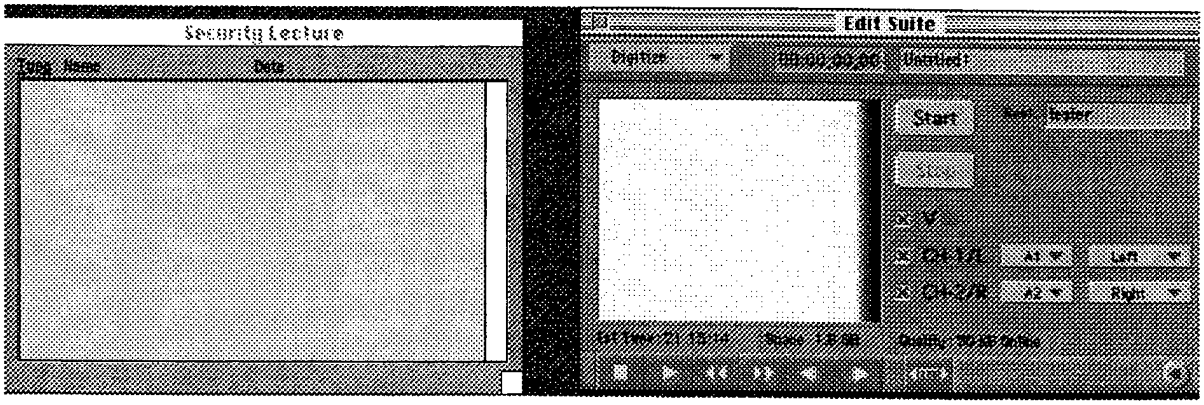

Figure 4: New Project & Edit Suite Windows From Ref. [7].

5. The user should enter a name in the “Reel” field of the Edit Suite Window; this name is used for digitizing clips.

D. DIGITIZING A CLIP

1. After launching the Media 100 application and creating or opening a project, place the previously recorded videotape in the video cassette recorder. The Project and Edit windows are employed when Digitizing or Exporting using a videotape. Remember, creating or opening a project automatically opens the Project Window.

2. Make sure that the “Edit Suite Window” is open; this is described in Section C.

3. Make sure the VCR is set to “REMOTE” (just under the power switch on the VCR).

NOTE: At this point, the video should have been viewed at least once. Have a good idea how the video would be laid out on paper (i.e., what the outline of the video looks like), and have a reasonable idea how large each clip of the video will be (i.e., know where to start and stop digitizing).

NOTE: The user should to break the video into manageable clips. When video is digitized, a large amount of hard drive space is required. Smaller, more

manageable clips reduces download time remotely.

NOTE: **Due to the large amount of memory required for digitizing and exporting, it is strongly recommended that the user digitize and export only one (or very few) clips at a time, unless the user has access to a large amount of hard drive space. It is during these processes that the user will edit the clip. Make sure the clip is fully edited before deleting the source. Once the source is deleted the user may no longer edit the clip.**

4. Make sure the Edit Suite Window is in "Digitize" mode (See Figures 3 and 4). This can be done by clicking on the pull down menu in the upper left had corner of the Edit Suite Window and selecting "Digitize".

5. Click the "play" button in the Edit Suite Window. This will start playing the videotape from the remote VCR: the video is displayed in the window. Make sure the video tape is in the general area of the video that you want to digitize. It's a good idea to have a little excess video in the beginning and at the end of the video. This excess can be edited out and ensures the entire clip is digitized.

6. Click on the "Start" button in the Edit Suite Window to initiate digitizing.

7. Let the system and the software do the rest until the process is finished for the respective portion of the video the user desires digitized. At that time, click on the "Stop" button in the Edit Suite Window.

8. A digitized and compressed analog video and audio source from the video tape has been successfully created.

9. Media 100 will automatically create a Bin Window and the first digitized video clip will be placed in this window.

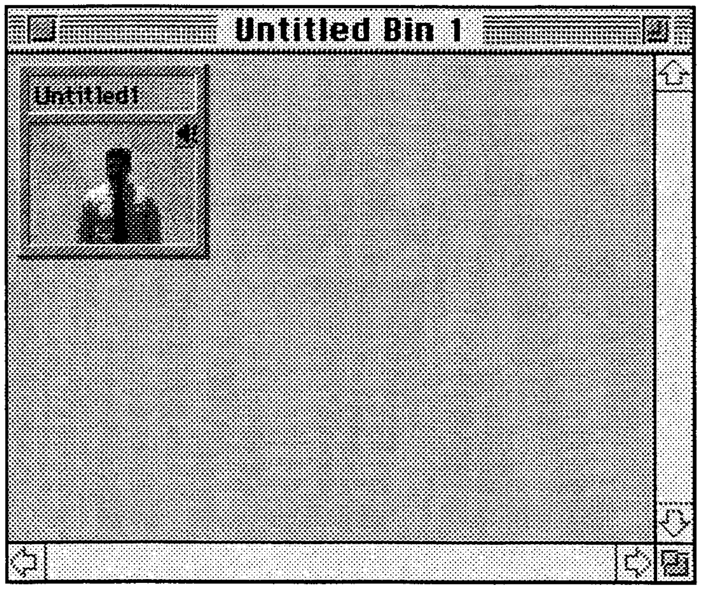

Figure 5: Bin Window From Ref. [7].

10. Referring to Figure 5, the user can see that both the Bin Window and the Video Clip are not titled. To name the Bin Window, go to "File" menu and select "Save Bin As...".

11. This displays a dialogue box similar to the following:

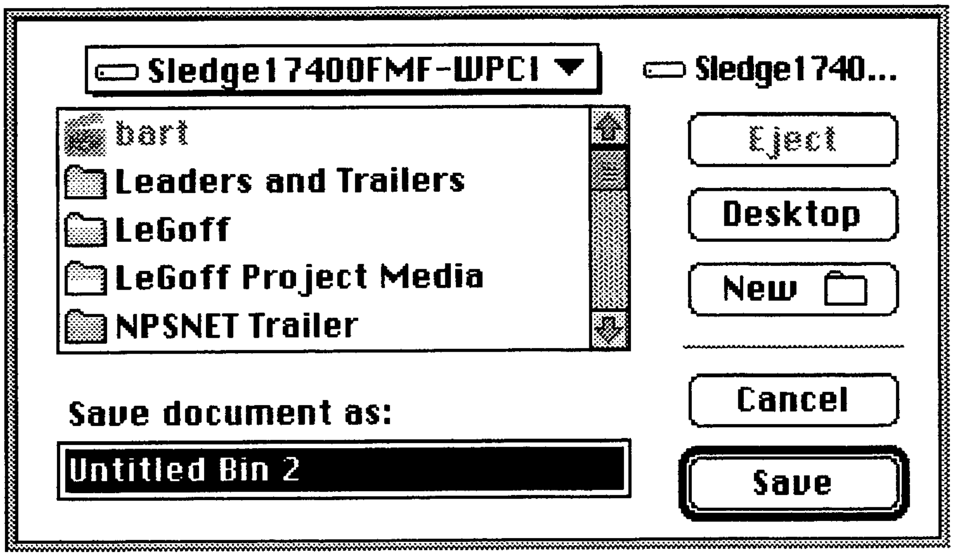

Figure 6: Bin Dialog Box From Ref. [7].

12. In the "Save document as:" field, enter an appropriate name for the Bin using the keyboard. Also select the area where the Bin file should be saved - saving the file in the same folder as the project file is best

NOTE: **It's a good idea to name Bins, Clips, and Projects intelligently (i.e., associate the name with the action.)**

13. Continue this process (steps 5 to 9) to digitize the remaining clips desired for the program.

NOTE: **As mentioned, digitizing video requires an immense amount of hard drive space for storing the digitized video. Unless the user has access to unlimited hard drive space, it is a good idea to digitize one (or very few) clips, edit those clips, export the clips, then delete or compress the digitized video. If the user deletes the digitized video, make sure the end product of the clip is complete before deletion.**

E. EXPORTING A CLIP AND RENDERING IT AS A QUICKTIME™ MOVIE

1. Once the video clip has been digitized, it is ready to be exported and rendered as a QuickTime™ Movie.

2. First, click on the digitized video clip(s). The clip(s) can be located in the associated bin that they are stored in (see Figure 5.)

3. Go to the menu bar at the top of the window and select "Edit Clip" from the "Tools" menu.

4. Then go to the menu bar at the top of the window and select "Export from Edit Suite" from the "File" menu.

5. This displays a dialog box similar to the following:

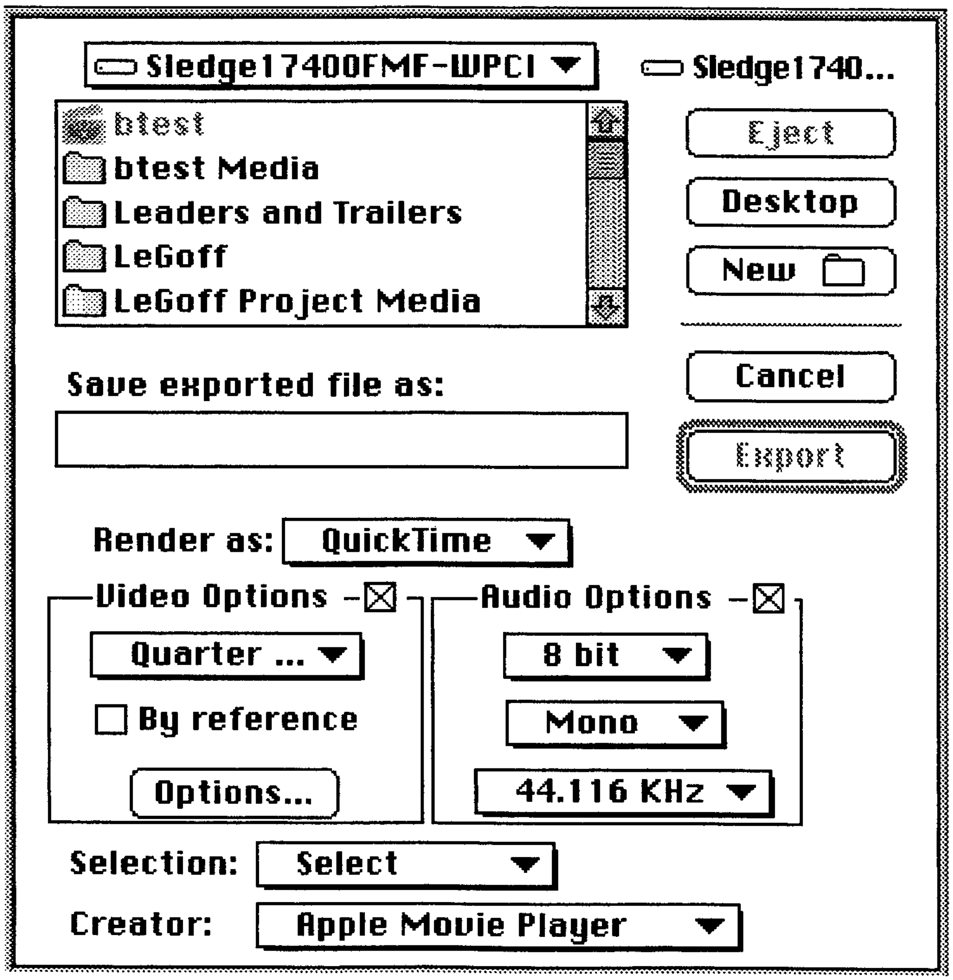

Figure 7: Export Dialog Box From Ref. [7].

6. This dialog box has some very important settings that require attention.

7. Next to the text "Render as:", click on the pull down menu and select "QuickTime" as the type of video to be exported.

8. In the "Save exported file as:" text field type in a name for the exported video clip. The name should uniquely identify the clip for future use (i.e., CD-ROM and HTML manufacturing).

   NOTE: **All QuickTime files should be saved with the dot three extension ".mov". Although the Macintosh does not use this extension, Unix machines and PCs require this in order to launch the movie correctly. This is important for multiplatform solutions.**

9. In the Video Options box (within the Export Dialog Box), click on the pull down menu and set the frame size to "Quarter Frame". This is important locally for memory conservation, and remotely for faster download time.

10. In the Audio Options box (within the Export Dialog Box), make sure the three settings read "8 bit", "Mono", and "44.116KHz". Testing proves these settings assist in both memory conservation and download time while providing the user with a good audio experience.

11. In the Selection box set the pull down menu to "Select".

12. In the Creator box set the pull down menu to "Create".

13. Return to the Video Options box and select "Options...". This brings up a dialogue box similar to the following:

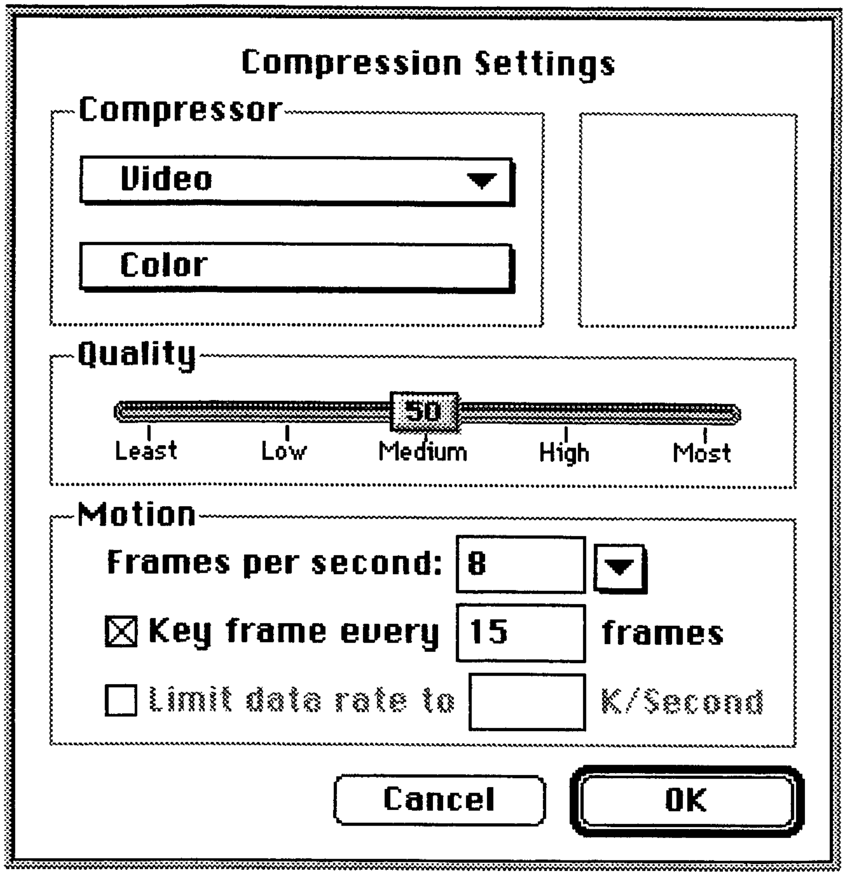

Figure 8: Compression Settings Dialog Box From Ref. [7].

14. This dialog box also has settings that require attention.

15. In the Compressor box of Compression Settings, scroll down and select "Video". This selection is based on an analysis of the picture quality vs. the hard drive space used. Once "Video" is selected "Color" is the default depth setting.

16. In the Quality Box of Compression Settings the selector should be set to "Medium" (or 50%). The gain in memory conservation and download time far outweigh the minor loss in picture quality.

17. The "Frames per second:" in the Motion Box of Compression Settings can be set at least as low as 8. In the examples used for this tutorial, the subjects (lecturers) did not move around. In this example, a high frame rate does not add to the quality of the image, but does require an enormous amount of hard drive space leading to excessive download times.

18. Set the "Key Frame" to 16. This refreshes the whole video image every 16 frames.

19. Click “OK” button.

20. This will bring the user back to the Export Dialog Box (Figure 7).

21. Click “Export” button.

22. This will export the clip as a QuickTime video. This process take approximately five times the amount of time it take to run the clip in real time.

    NOTE: **The Clip should be properly edited prior to exporting. Once the clip is exported, it can be re-edited and re-exported. However, once the clip is exported and the video source is deleted (for local memory conservation), the clip can no longer be further edited. It can still be used for CD-ROM and HTML manufacture, though.**

F. RECORDING A CD-ROM

1. Acquire an unused CD-ROM disk. These disk cost approximately $7 per disk at the time this tutorial was written.

2. Insert the disk into the CD-ROM Burner device.

3. Find and launch the “Toast CD-ROM Pro 3.0.2” application.

4. This will display a dialogue box similar to the following:

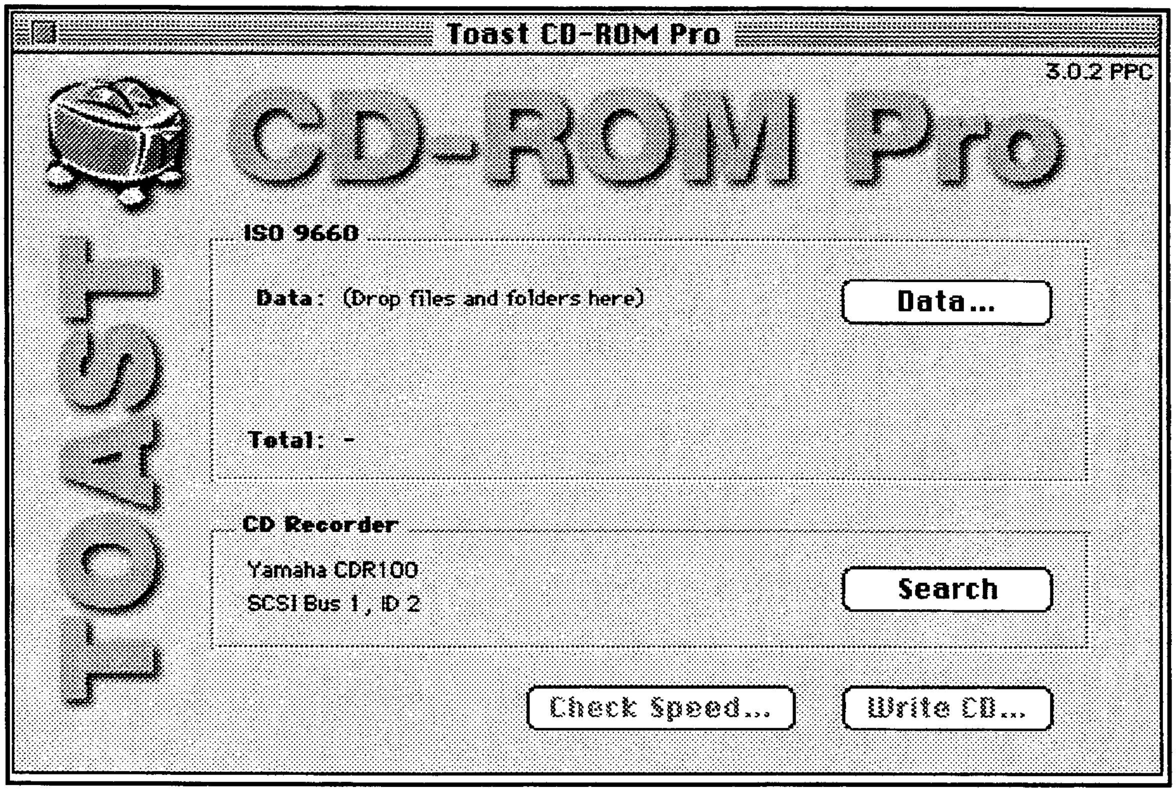

Figure 9: CD-ROM Burner Application From Ref. [2].

5. Referring to Figure 9, where it displays "ISO 9660" is actually a drop down menu. If some other text is displayed (other than ISO 9660) then click on the text and select "ISO 9660" from the choices. This format is readable by all major computer operating systems and ensures that the CD-ROM can be used on Apple Macintosh, Windows, or Unix machines.

6. Click on the "Data..." button.

7. This will display a dialogue box similar to the following:

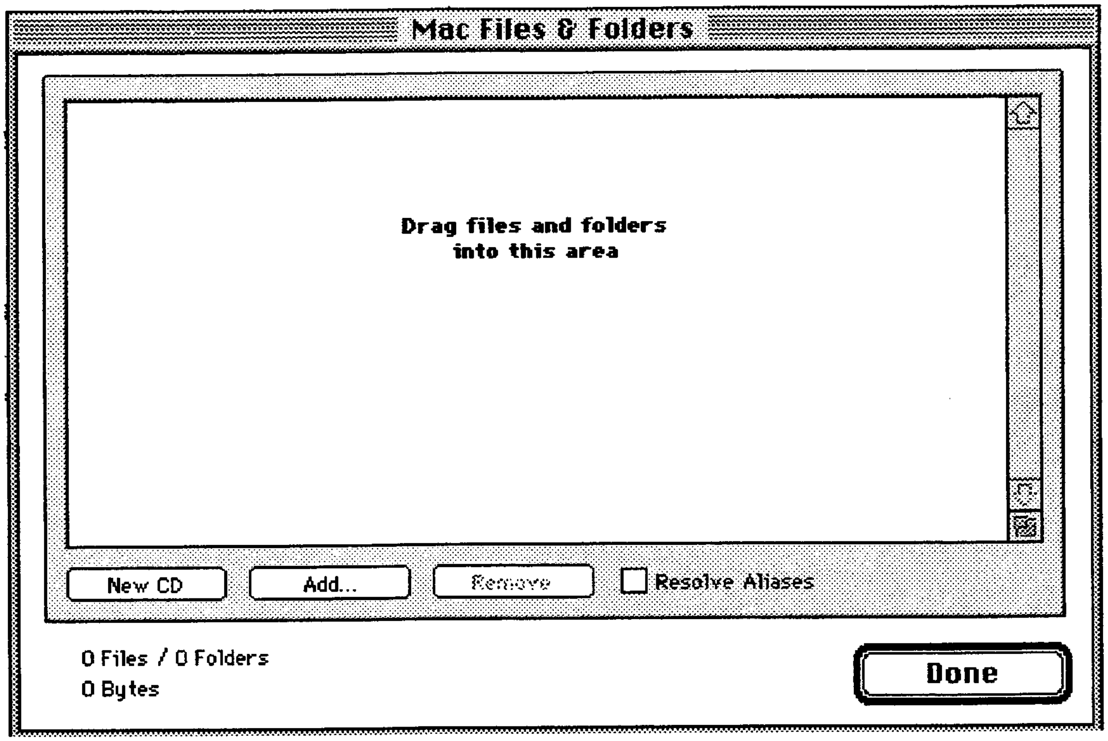

Figure 10: CD-ROM Data Folder From Ref. [2].

8. Bring all video clips into the CD-ROM Data Folder by highlighting the clips and dragging them into the CD-ROM Data Folder. All clips in a window can be highlighted by selecting typing ð-A on the keyboard.

9. Click the "Add" button and drag index.html into the "Drag files and folders into this area" portion of Figure 10.

10. Click the "Add" button and drag folder with video clips into the "Drag files and folders into this area" portion of Figure 10.

11. Click the "Done" button.

12. This will bring the user back to Figure 9.

13. Click the "Write CD" button.

14. Click the "Write Disk" button.

G. RECORDING A CD-ROM PRODUCTION FOR CROSS PLATFORM USE

1. Use the Media 100 system to digitize a videotape.

2. The video clips that were digitized by the Media 100 have extra information that causes problems when trying to play the QuickTime video on non-Macintosh computers. This problem can be solved using the "MoviePlayer" application.

3. Find and launch the "MoviePlayer" application.

4. Go to the menu bar at the top of the window and select "Open..." from the "File" menu.

5. Select the QuickTime movie that is to be used on other platforms. Click on the "Open" button.

6. Go to the menu bar at the top of the window and select "Save As..." from the "File" menu. This displays a dialogue box similar to the following:

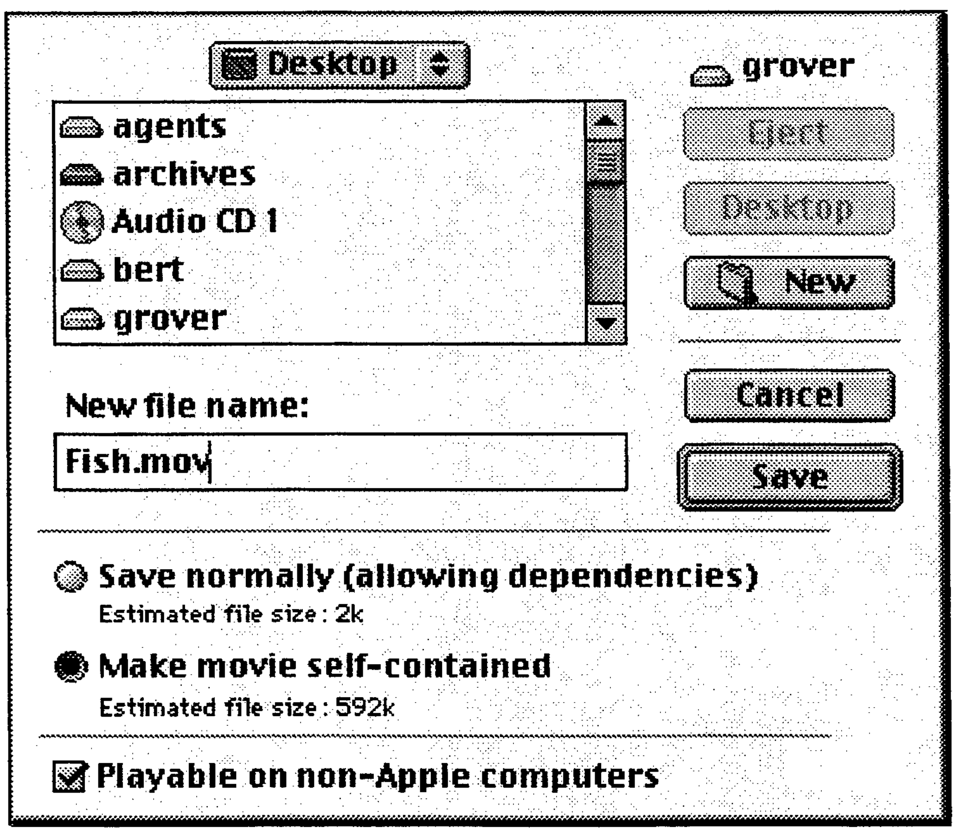

Figure 11: Save As... Dialogue From Ref. [16].

7. Click on the radio button "Make movie self-contained".

8. The checkbox for "Playable on non-Apple computers" is now active. Click on this box to make it active. The window should display the same selections as the above figure.

9. Click the "Save" button. This version of the movie can now be burned onto a CD-ROM or placed on the Internet, where it can be viewed by any computer that supports QuickTime.

H. READING A CD-ROM USING THE HTML OUTLINE (MACINTOSH)

1. Place the CD-ROM in the reader drive.

2. An icon will appear on the Desktop with the name of the CD-ROM. In this case, the CD is named SECURITY:

Figure 12: CD-ROM Icon From Ref. [7].

3. Double-click the icon. This will open a window with a folder (contents of which are each clip), and an INDEX.HTM page previously created.

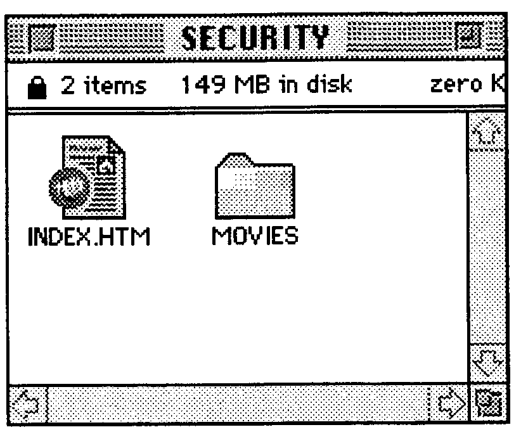

Figure 13: Contents of CD-ROM Production From Ref. [7].

4. Bring up Netscape, Internet Explorer, or the browser of choice.

5. Drag and drop the INDEX.HTM icon onto the browser

6. This will bring up a Browser Window which will have a "file:///Cdname/INDEX.HTM" path associated with it. See Figure 14.

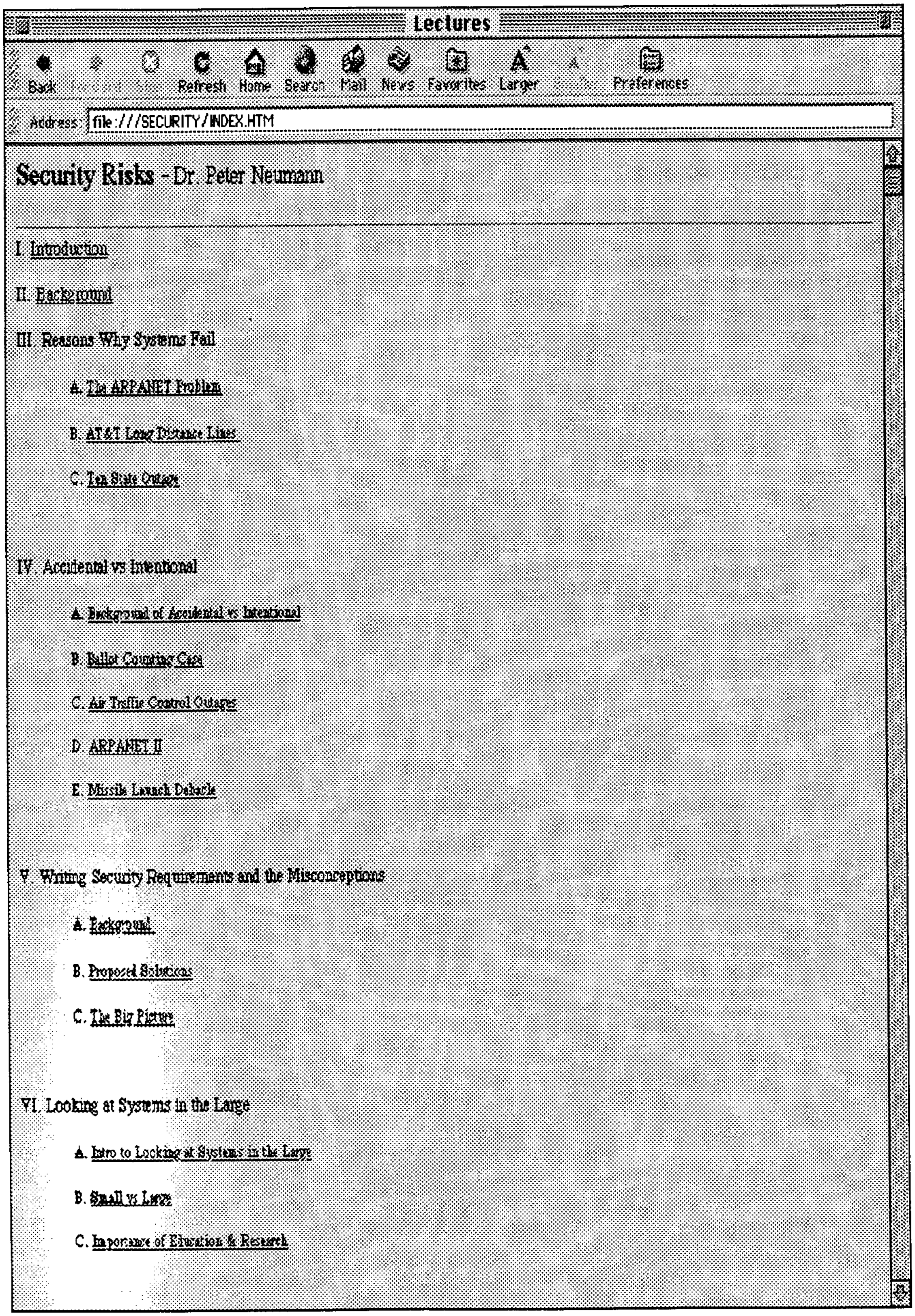

Figure 14: HTML Web Page From Ref. [7].

7. This will set up the proper environment for the user to view the video clip locally (off the CD-ROM) using the HTML (web) outline. This generally allows faster throughput than viewing the clips by downloading them off the net.

I. READING THE CD-ROM LOCALLY USING THE HTML OUTLINE (PC)

1. This assumes the user is employing a Microsoft Windows 95 operating system.

2. Place disk in CD-ROM drive.

3. Click the "My Computer" icon.

4. Click the CD-ROM icon.

5. This will bring up a window with a folder (contents of which are each clip), and an INDEX.HTM page previously created. See Figure 13.

6. If the browser is already up, double click the INDEX.HTM Icon. Otherwise, bring the browser up and do the same.

7. This will set up the proper environment for the user to view Clip of choice locally (off the CD) using the html (web) outline. This generally allows faster throughput than viewing the clips by downloading them off the net.

J. UPLOADING MOVIES (CLIPS) TO A WEB PAGE

1. Find and launch the "Anarchie" application. Anarchie is an FTP client.

2. Go to the menu bar at the top of the window and select "FTP..." from the "FTP" menu.

3. This will display the “Get via FTP” dialogue box which requires some user information. See Figure 15.

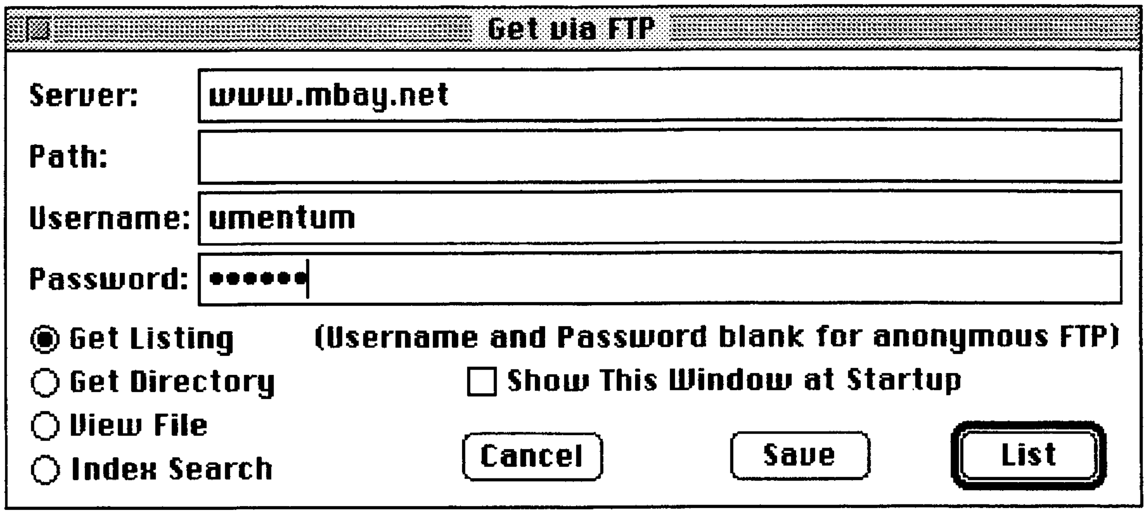

Figure 15: Get FTP Dialog Box From Ref. [5].

NOTE: **The user must have an account that supports the upload of mass data. Most typical Internet providers will not support greater than 10 Megabytes uploaded to an individual account.**

4. Input in the name of the server in the “Server” field of the dialog box. In this case, the author had an account with mbay.net. The mbay.net webserver is named *www.mbay.net*.

5. Input the user name of the account in the “Username” field.

6. Input the password in the “Password” field. Note in Figure 18 that the password will not be displayed on the screen but is instead displayed as bullets (••••).

7. Make sure “Get Listing” is selected.

8. Click on “List” button at the bottom right hand corner of the dialog box.

9. This brings up the users personal directory window.

10. The user should then create a directory where all the movie folders will be uploaded. It is assumed that the user wants separate folders for each specific lecture or production. Create a new directory by selecting “New

Directory" from the "FTP" menu item in the menubard.

11. This will bring up a "New Directory" window. Enter the desired name for the new directory in the "Name" field.

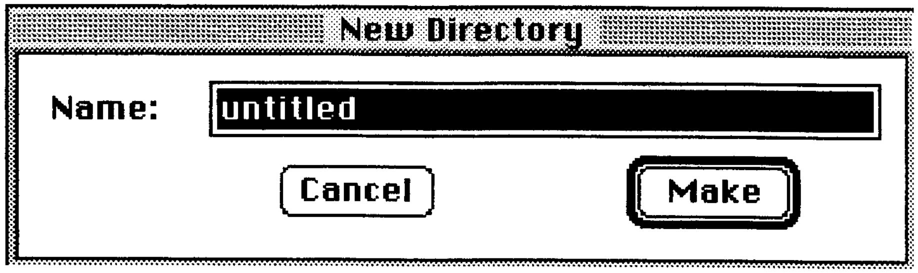

Figure 16: New Directory Window From Ref. [5].

12. At this point it is assumed that a CD-ROM of the movies exists. If a CD-ROM has not been created, refer to Section F, "How to Burn a Compact Disk", and create one.

13. Make sure the CD-ROM is in the reader drive and an icon for that CD-ROM is on the desktop.

14. Double click that CD-ROM icon.

15. This will bring up a window which has two items in it: the INDEX.HTM icon and a folder with the selected clips (this folder is already named.)

16. Click and drag the INDEX.HTM file icon into the newly created directory window. The INDEX.HTM file acts as an outline of the entire production to guide the user sequentially or directly through the entire production.

17. Go to the "File" menu in the menu bar and select "Retry" to refresh the INDEX.HTM in the new directory window.

18. Then go back to the CD window and double click on the folder where all the clips originally stored. This will bring up a window with Icons of all manufactured clips.

19. Click on that window.

20. While in that window, go to "Edit" menu in the menu bar and select "Select All" to select all the clips.

21. Drag all the clips to the newly created directory.

22. This will transfer all your clips to that directory of the account.

23. Go to "File" menu in the menu bar and select "Retry" to refresh the clips in the new directory window.

    NOTE: **A lot of data may be uploaded. The user should make sure how much data is being uploaded and that the account supports such an upload.**

24. Make sure that the names of the files on the web site match all of the names and paths stored in the HTML files.

    NOTE: **Remember that Unix is case-sensitive.**

25. All videos are now uploaded to the Internet.

INITIAL DISTRIBUTION LIST

1.	Defense Technical Information Center 8725 John J. Kingman Rd., STE 0944 Ft. Belvoir, Virginia 22060-6218	2
2.	Dudley Knox Library Naval Postgraduate School 411 Dyer Rd. Monterey, California 93943-5101	2
3.	Chairman, Code CS Computer Science Department Naval Postgraduate School Monterey, CA 93943-5000	1
4.	Cynthia Irvine Code CS/CI Computer Science Department Naval Postgraduate School Monterey, CA 93945-5100	2
5.	Geoffrey Xie Code CS/GX Computer Science Department Naval Postgraduate School Monterey, CA 93945-5100	2
6.	Dr. Blaine W. Burnham R23 National Security Agency 9800 Savage Road Ft. George G. Meade, MD 20755-6000	1
7.	George Briber Defense Information Systems Agency 5113 Leesburg Pike Suite 400 Falls Church, VA 22041-3230	1

8.	Commanding Officer (Attn: Code 30, CDR Zellmann) Naval Information Warfare Activity 9800 Savage Rd. Ft. Meade, MD 20755-6000	2
9.	ECJ6-NP HQ USEUCOM Unit 30400 Box 1000 APO AE 09128	1
10.	Commander, Naval Security Group Headquarters Naval Security Group Headquarters 9800 Savage Rd. Ft. Meade, MD 20755-6585	1
11.	John H. Umentum 3040 Big Creek Road Green Bay, WI 54311	1